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# **DEPARTMENT OF TRANSPORTATION**

## **FEDERAL AVIATION ADMINISTRATION**

### **SPECIFICATION**

**MICROWAVE LANDING SYSTEM (MLS)  
INTEROPERABILITY AND PERFORMANCE REQUIREMENTS**



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MICROWAVE LANDING SYSTEM (MLS)  
INTEROPERABILITY AND PERFORMANCE REQUIREMENTS

1. SCOPE AND CLASSIFICATION

1.1 Scope.- This standard provides the interoperability and performance requirements for the Microwave Landing System (MLS) equipment produced for use in the National Airspace System (NAS). Many of the requirements contained in this standard also are applicable to MLS equipment (e.g., military tactical systems) produced for special purposes.

1.2 Purpose.- This document provides the signal format standards that will insure interoperability between all ground and airborne MLS equipment and provides the essential technical requirements of MLS ground equipment, consistent with ICAO Standards and Recommended Practices (SARPS).

1.3 MLS system description

1.3.1 General.- The MLS is an air-derived system in which ground-based equipment transmit angular position and data signals to a receiver in the aircraft, and range information is provided by a conventional DME technique. Thus, the position information is provided as two angle coordinates and a range coordinate; data are transmitted in digital form. The channel plan provides 200 MLS channels as shown in Table 12.

1.3.2 Signal format.- Each angle guidance and data function contains a unique identification code which allows time-multiplexed transmissions on a single frequency between 5031 and 5090.7 MHz. The transmission sequences are randomized to reduce synchronous interference effects. The range information is provided by Precision Distance Measuring Equipment (DME/P) transmitting asynchronously in the frequency band between 979 and 1213 MHz. The DME/P uses an interrogate/reply format which is compatible with conventional DME.

1.3.3 Signal characteristics.- The angle guidance information is represented as the time difference between successive passages of an unmodulated, fan-shaped, scanning beam. The range information is represented by the elapsed time measured in the aircraft between the interrogator and transponder fast rise-time pulses. The data transmissions which identify each angle function and provide basic (and auxiliary) data are differentially encoded and modulated by phase shift keying of the RF carrier.

1.3.4 Airborne receiver functions.- The airborne equipment receives the ground generated signals associated with each function and, in sequence, determines the identity of the function and then decodes the scanning beam angle or data information. It subjects the received signals to acquisition criteria before they are accepted and continues validation following

acceptance to provide reliable information. The DME/P airborne interrogator/receiver functions similarly to that of a conventional DME.

1.3.5 Monitoring.— The ground and airborne equipment are monitored to assure system performance and integrity and to provide the necessary alarms and alerts.

#### 1.4 Classification

1.4.1 Standard MLS.— The standard configuration of the MLS shall be composed of the following:

- (a) Approach Azimuth equipment, and associated monitor, remote control and indicator equipment.
- (b) Approach Elevation equipment, and associated monitor, remote control and indicator equipment.
- (c) Equipment for the encoding and transmission of essential data words, associated monitor, remote control and indicator equipment.

NOTE: Essential data words are Basic Data and Auxiliary Data words A1, A2, A3, and A4.

- (d) Precision Distance Measuring Equipment (DME/P), and associated monitor, remote control and indicator equipment.

NOTE: In some cases a conventional DME may satisfy operational requirements.

1.4.2 Expansion of the standard MLS.— The signal format structure allows expansion of the standard MLS configuration by addition of one or more of the following functions or characteristic improvements:

- (a) Back Azimuth equipment, and associated monitor, remote control and indicator equipment. Where Back Azimuth is provided, a means for transmission of basic data word 5 and auxiliary data word 4 shall also be provided.
- (b) Provisions for the encoding and transmission of additional non-essential auxiliary data words, associated monitor, remote control and indicator equipment.
- (c) Larger proportional guidance sectors.

NOTE: Additional time is available in the signal format to accommodate functions not yet standardized.

1.5 Definitions.- The following definitions are pertinent to this standard:

1.5.1 Approach Azimuth.- Equipment which provides lateral guidance to aircraft in the approach and runway regions. This equipment may radiate the Approach Azimuth function or the High Rate Approach Azimuth function along with appropriate basic data.

1.5.2 Approach Elevation.- The equipment which provides vertical guidance in the approach region. This equipment radiates the Approach Elevation function.

1.5.3 Auxiliary Data.- Data, transmitted in addition to basic data, that provide ground equipment siting information for use in refining airborne position calculations and other supplementary information.

1.5.4 Back Azimuth.- The equipment which provides lateral guidance in the Back Azimuth and runway regions. This equipment radiates the Back Azimuth function along with appropriate basic data.

1.5.5 Basic Data.- Data transmitted by the ground equipment that are associated directly with the operation of the landing guidance system.

1.5.6 Beam center.- The midpoint between the -3 dB points on the leading and trailing edges of the scanning beam main lobe.

1.5.7 Beam width.- The width of the scanning beam main lobe measured at the -3dB points and defined in angular units on the antenna boresight, in the horizontal plane for the azimuth function and in the vertical plane for the elevation function.

1.5.8 Clearance guidance sector.- The volume of airspace, inside the coverage sector, within which the azimuth guidance information is not proportional to the angular displacement of the aircraft. Instead it is a constant fly-left or fly-right indication of the direction, relative to the approach course, that an inbound aircraft should fly in order to enter the proportional guidance sector. Also the corresponding volume of airspace in the back azimuth coverage sector for aircraft outbound.

1.5.9 Control motion noise (CMN).- That portion of the guidance signal error which could affect aircraft attitude and cause control surface, wheel and column motions during coupled flight, but which does not cause aircraft displacement from the desired course or glide path, (CMN measurement methodology is defined in paragraph 6).

1.5.10 Coordinate system - conical.- A function is said to use conical coordinates when the decoded guidance angle varies as the minimum angle between the surface of a cone containing the receiver antenna, and a reference plane perpendicular to the axis of the cone and passing through its apex. The apex of the cone is at the antenna phase center and contains the zero-degree azimuth radial. For Approach Azimuth or Back Azimuth functions, the reference plane is vertical and contains the zero degree azimuth radial. For Elevation functions the reference plane is horizontal. (See Figures 21 and 22).

1.5.11 Coordinate system - planar.- A function is said to use planar coordinates when the decoded guidance angle varies as the angle between the plane containing the receiver antenna and a reference plane. For azimuth functions, the reference plane is the vertical plane containing the 0 degree azimuth radial and the plane containing the receiver antenna is a vertical plane passing through the antenna phase center. (See Figure 21).

1.5.12 Coverage sector.- A volume of airspace within which service is provided by a particular function and in which the signal power density is equal to or greater than the specified minimum.

1.5.13 DME/P.- The range function associated with the MLS. It is a distance measuring equipment (DME) that is compatible with standard navigation DME while providing improved accuracy and additional channel capabilities.

1.5.14 Effective sidelobes.- The level of antenna sidelobes which, when caused to interfere with the antenna main lobe under conditions of unity reflection and static worst-case phase, causes an error not exceeding a specified value.

1.5.15 Flare coverage zone.- A zone that extends horizontally between the runway edges and longitudinally from 90 meters (300 feet) to 760 meters (2500 feet) along the runway from threshold and vertically from near the runway surface to a height of 45 meters (150 feet).

1.5.16 Function.- A particular service provided by the MLS e.g., Approach Azimuth guidance, Back Azimuth guidance or Basic Data, etc.

1.5.17 Guidance sector.- The area on the ground, above which MLS angle guidance is transmitted. The ground area frequently is a portion of a circle that is bounded by two radii and an intercepted arc.

1.5.18 Mean course error.- The mean value of the azimuth error along the runway extended centerline.

1.5.19 Mean glide path error.- The mean value of the elevation error along the specified glide path.

1.5.20 Minimum glide path.- The lowest angle of descent along the zero degree azimuth that is consistent with published approach procedures and obstacle clearance criteria.

1.5.21 MLS approach reference datum.- A point at a specified height located vertically above the intersection of the runway centerline and the threshold.

1.5.22 MLS Back Azimuth reference datum.- A point at a specified height above the runway center line at the runway midpoint.

1.5.23 MLS datum point.- The point on the runway centerline closest to the phase center of the Approach Elevation antenna.

1.5.24 Out-of-coverage indication (OCI) signal.— A signal radiated into areas outside the intended coverage sector where required to prevent removal of an airborne warning indication in the presence of misleading guidance information.

1.5.25 Path following error (PFE).— That portion of the guidance signal error which could cause aircraft displacement from the desired course or glide path. These perturbations fall within the loop guidance bandwidth of an aircraft. The path following error is composed of the path following noise and the mean course error, in the case of azimuth functions, or the mean glide path error, in the case of elevation functions, (PFE measurement methodology is defined in paragraph 6.).

1.5.26 Path following noise (PFN).— That portion of the guidance signal error which could cause aircraft displacement from the mean course line or mean glide path as appropriate.

1.5.27 Proportional guidance sector.— The volume of airspace within which the angular guidance information provided by a function is directly proportional to the angular displacement of the airborne antenna with respect to the zero angle reference.

1.5.28 Separation angle.— The difference between the angle coding of the direct signal and the angle coding of a multipath signal.

1.5.29 Time division multiplex (TDM).— A method of sequentially transmitting a number of functions on a single frequency channel by means of time separation.

1.5.30 TO and FRO scan.— The first and second scans (respectively) of the scanning beam from one coverage limit to the other. The direction of the FRO scan is opposite to the direction of the TO scan.

## 2. APPLICABLE DOCUMENTS

2.1 Incorporated documents.— (Not used.)

2.2 Information documents.— The following publications provide information on MLS operational requirements and avionics characteristics.

- (a) International Civil Aviation Organization, International Standards and Recommended Practices, Aeronautical Telecommunications, Annex 10.
- (b) FAA Handbook 8260.3 United States Standard for Terminal Instrument Procedures (TERPS).
- (c) Radio Technical Commission for Aeronautics, Minimum Operational Performance Standards for Microwave Landing System Airborne Receiver Equipment, Doc. No. DO-177.
- (d) Radio Technical Commission for Aeronautics, Minimum Operational Performance Standards for Airborne Distance Measuring Equipment (DME) Operating Within the Frequency Range of 960-1215 MHz, Doc. No. DO-189.

### 3. SYSTEM REQUIREMENTS, ANGLE AND DATA FUNCTIONS

#### 3.1 Radiated signal characteristics

##### 3.1.1 Channeling

3.1.1.1 Channel arrangement.— The MLS angle and data functions shall operate between 5031 MHz and 5090.7 MHz on any one of the 200 channels shown in Table 12, Appendix I.

3.1.1.2 Channel pairing with DME/P.— The channel pairing with the L-band ranging function shall be in accordance with Table 12, Appendix I.

##### 3.2 Signal format organization

3.2.1 Angle guidance functions.— The organization of angle guidance functions shall be as shown in Figure 1. The function shall begin with a preamble time slot followed by time slots for sector signals, and scanning beam signals.



Figure 1. Angle Function Organization

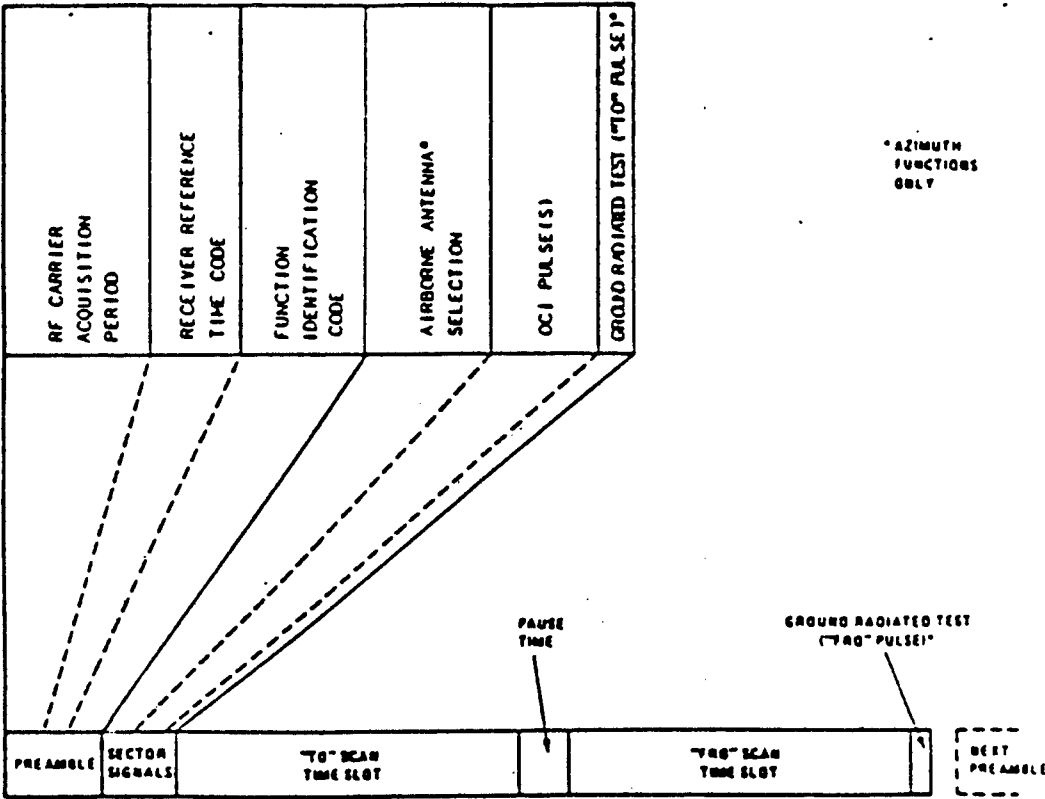
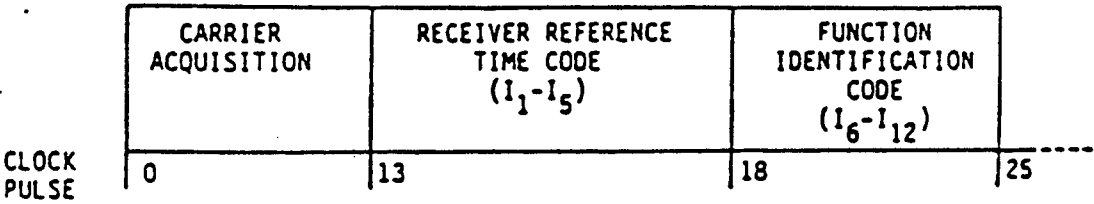


Figure 2. Preamble Organization



3.2.1.1 Preamble.— A preamble signal shall be transmitted throughout the applicable coverage sector to identify the particular function to follow. The preamble shall consist of a radio frequency carrier acquisition period, a receiver reference time code, and a function identification code as shown in Figure 2.

3.2.1.1.1 Carrier acquisition.— The preamble transmission shall begin with a period of unmodulated radio frequency carrier.

3.2.1.1.2 Receiver reference time code.— The receiver reference time code 11101 (bits  $I_1$  to  $I_5$ ), shall follow the carrier acquisition period. The time of the last phase transition midpoint in the code shall be the receiver reference time.

3.2.1.1.3 Function identification code.— A code for function identification shall follow the receiver reference time code. The code shall consist of the five information bits ( $I_6$  to  $I_{10}$ ) allowing identification of 31 different functions, plus two parity bits ( $I_{11}$  to  $I_{12}$ ) as shown in Table 1.

Table 1. Function Identification Codes

| FUNCTION                   | CODE  |       |       |       |          |          |          |
|----------------------------|-------|-------|-------|-------|----------|----------|----------|
|                            | $I_6$ | $I_7$ | $I_8$ | $I_9$ | $I_{10}$ | $I_{11}$ | $I_{12}$ |
| APPROACH AZIMUTH           | 0     | 0     | 1     | 1     | 0        | 0        | 1        |
| HIGH RATE APPROACH AZIMUTH | 0     | 0     | 1     | 0     | 1        | 0        | 0        |
| APPROACH ELEVATION         | 1     | 1     | 0     | 0     | 0        | 0        | 1        |
| FLARE                      | 0     | 1     | 1     | 0     | 0        | 0        | 1        |
| BACK AZIMUTH               | 1     | 0     | 0     | 1     | 0        | 0        | 1        |
| 360° AZIMUTH               | 0     | 1     | 0     | 0     | 1        | 0        | 1        |
| BASIC DATA 1               | 0     | 1     | 0     | 1     | 0        | 0        | 0        |
| BASIC DATA 2               | 0     | 1     | 1     | 1     | 1        | 0        | 0        |
| BASIC DATA 3               | 1     | 0     | 1     | 0     | 0        | 0        | 0        |
| BASIC DATA 4               | 1     | 0     | 0     | 0     | 1        | 0        | 0        |
| BASIC DATA 5               | 1     | 1     | 0     | 1     | 1        | 0        | 0        |
| BASIC DATA 6               | 0     | 0     | 0     | 1     | 1        | 0        | 1        |
| AUXILIARY DATA A           | 1     | 1     | 1     | 0     | 0        | 1        | 0        |
| AUXILIARY DATA B           | 1     | 0     | 1     | 0     | 1        | 1        | 1        |
| AUXILIARY DATA C           | 1     | 1     | 1     | 1     | 0        | 0        | 0        |

NOTE 1: The function identification codes have been chosen so that parity bits  $I_{11}$  and  $I_{12}$  satisfy the equations:

$$I_6 + I_7 + I_8 + I_9 + I_{10} + I_{11} = \text{EVEN}$$

$$I_6 + I_8 + I_{10} + I_{12} = \text{EVEN}$$

### 3.2.1.2 Sector signals

3.2.1.2.1 Azimuth functions.— The transmission format of any azimuth function shall include time slots for ground equipment identification, airborne antenna selection, out-of-coverage indication, and test pulses.

3.2.1.2.1.1 Airborne antenna selection signal.— A signal for airborne antenna selection shall be transmitted as a "zero" DPSK signal lasting for a six-bit period. The signal shall be available throughout the coverage sector in which Approach or Back Azimuth guidance is provided.

NOTE: The signal provides an opportunity for the selection of the most appropriate antenna in a multiple antenna airborne installation.

3.2.1.2.1.2 Out-of-coverage indication pulses.— In the installed environment, where out-of-coverage indication pulses are used, they shall be: (1) greater than any guidance signal in the out-of-coverage sector, (2) at least 5 dB less than the clearance signal level within the adjacent clearance sector, and (3) at least 5 dB less than the scanning beam signal level within the proportional coverage region. The duration of each pulse measured at the half amplitude point shall be at least 100 microseconds, and the rise and fall times shall be less than 10 microseconds. It shall be permissible to sequentially transmit two pulses in each out-of-coverage indication time slot. Where pulse pairs are used, the duration of each pulse shall be at least 50 microseconds, and the rise and fall times shall be less than 10 microseconds. The transmission of out-of-coverage indication pulses from antennas with overlapping coverage patterns shall be separated by at least 10 microseconds.

3.2.1.2.1.3 Ground radiated test signals.— Time slots shall be reserved in the Approach and Back Azimuth signal formats for the future use of ground radiated test signals.

3.2.1.2.2 Approach Elevation function.— The transmission format of the Approach Elevation function shall provide a time slot for an out-of-coverage indication (OCI) pulse.

3.2.1.2.2.1 Out-of-coverage indication pulse.— In the installed environment, where an out-of-coverage indication pulse is used, it shall be: (1) greater than any guidance signal in the out-of-coverage indication sector and (2) at least 5 dB less than the guidance signals within the guidance sector. The duration of the pulse measured at the half amplitude points shall be at least 100 microseconds, and the rise and fall times shall be less than 10 microseconds. It shall be permissible to sequentially transmit two pulses in the out-of-coverage indication time slot. Where pulse pairs are used, the duration of each pulse shall be at least 50 microseconds, and the rise and fall times shall be less than 10 microseconds.

3.2.1.3 Angle guidance signals

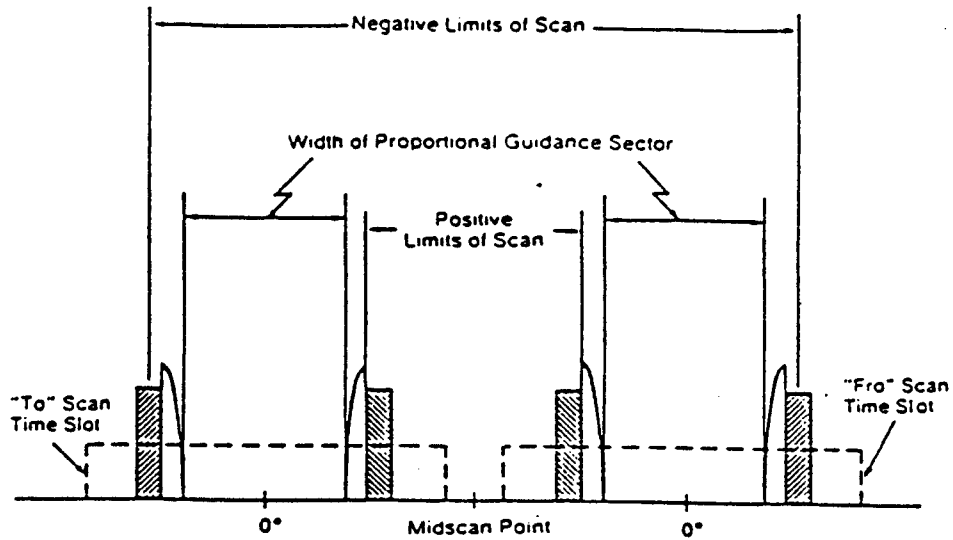
3.2.1.3.1 Azimuth clearance signals

3.2.1.3.1.1 Fly left/fly right clearance pulses.— For azimuth equipment which provides proportional coverage less than  $\pm 40$  degrees, clearance guidance shall be provided to produce a minimum guidance sector of  $\pm 40$  degrees. Clearance guidance may be provided by scanning beyond the proportional coverage limits as designated in basic data or, alternately, by the transmission of fly left/fly right clearances pulses in the formats for the approach azimuth, high rate approach azimuth and back azimuth functions. When provided, clearance pulses shall conform to the following:

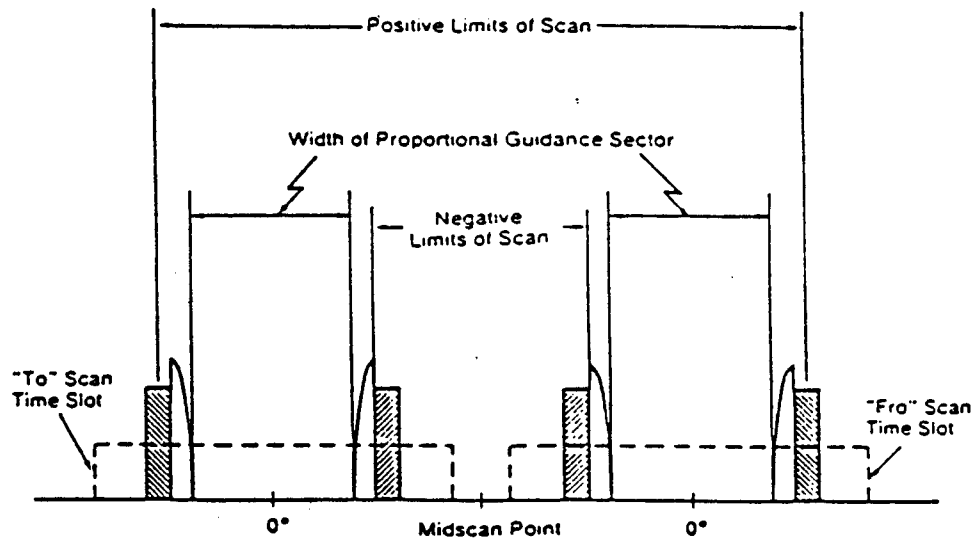
- (a) Clearance guidance information shall be provided by transmitting pairs of pulses within the angle scan time slots. One pair shall consist of one pulse adjacent to the start time of the scanning beam TO scan and one pulse adjacent to the stop time of FRO scan. A second pair shall consist of one pulse adjacent to the stop time of the scanning beam TO scan and one pulse adjacent to the start time of the FRO scan. The fly right clearance pulses shall represent positive angles and the fly left clearance pulses shall represent negative angles. The duration of each clearance pulse shall be 50 microseconds with a tolerance of plus or minus 5 microseconds measured at the half-amplitude points. The transmitter switching time between the clearance pulses and the scanning beam transmissions shall not exceed 10 micro-seconds. The rise time at the edge of each clearance pulse not adjacent to the scanning beam shall be less than 10 microseconds.
- (b) In the installed environment: within the fly right clearance guidance sector, the fly right clearance guidance signal shall exceed the scanning beam sidelobes and all other guidance and OCI signals by at least 5 dB; within the fly left clearance guidance sector, the fly left clearance guidance signal shall exceed the scanning beam sidelobes and all other guidance and OCI signals by more than 5 dB; within the proportional guidance sector, the clearance guidance signals shall be at least 5 dB below the proportional guidance signal.
- (c) Where used clearance pulses shall be transmitted adjacent to the scanning beam signals at the edges of proportional coverage as shown in the timing diagrams in Figure 4. The proportional coverage boundary shall be established at one beamwidth inside the scan start/stop angles, such that the transition between scanning beam and clearance signals occurs outside the proportional coverage sector.
- (d) When clearance pulses are provided in conjunction with a one-degree beamwidth scanning antenna, the scanning beam antenna shall radiate for 15 microseconds while stationary at the scan start/stop angles.

NOTE 1: The proportional coverage limits are transmitted in basic data as specified in 3.6.

Figure 4. Clearance Pulse Conventions



(a) Approach Azimuth



(b) Back Azimuth

**Legend**

Clearance  
Pulses

 Fly-Left

 Fly-Right

Scanning Beam  
Pulses

 Start Scan

 Stop Scan

NOTE 2: It is not intended to limit the use of clearance pulses to the minimum sectors specified in 4.2 when operational advantages can be gained by providing a wider guidance sector.

### 3.2.1.3.2 Proportional guidance signals

3.2.1.3.2.1 Angle guidance encoding.— Angle guidance information shall be encoded by the amount of time separation between the centers of the received TO and FRO scanning beam main lobes. The coding shall be interpreted in the airborne equipment as a linear function of time as follows:

Where:

$T_0$  = Time separation in microseconds between TO and FRO beam centers corresponding to zero degrees.

$t$  = Time separation in microseconds between TO and FRO beam centers.

$V$  = Scan velocity scaling constant in degrees per microseconds.

3.2.1.3.2.2 Angle parameter values.— The values of the angle guidance parameters shall be as shown in Table 2.

Table 2. Value of Angle Guidance Parameters

| Function                   | Maximum Scan Angle (degrees) | Value of $t$ for Maximum Scan Angle (usec) | $T_0$ (usec) | $V$ (degrees/usec) |
|----------------------------|------------------------------|--|--------------|--------------------|
| APPROACH AZIMUTH HIGH RATE | -62 to +62                   | 13 000                                     | 6 800        | +0.020             |
| APPROACH AZIMUTH           | -42 to +42                   | 9 000                                      | 4 800        | +0.020             |
| BACK AZIMUTH               | -42 to +42                   | 9 000                                      | 4 800        | -0.020             |
| APPROACH ELEVATION         | -1.5 to +29.5                | 3 500                                      | 3 350        | +0.020             |
| FLARE ELEVATION            | -2 to +10                    | 3 200                                      | 2 800        | +0.010             |

Note: The maximum scan angles shown recognize that the scan angle must exceed the proportional coverage limit by at least one half of the width of the detected scanning beam envelope (in equivalent angle) to allow successful decoding.

3.2.1.3.2.3 Tolerances.— The tolerances on the ground equipment scanning beam velocity and the time separation between TO and FRO pulses corresponding to zero degrees shall be sufficient to satisfy the accuracy requirements specified in 4.3.

3.2.1.3.2.4 Azimuth scanning convention.— Scanning conventions for Azimuth guidance signals shall be in accordance with Figure 5. Each angle guidance transmission shall consist of a clockwise TO-scan followed by a counter-clockwise FRO-scan as viewed from above the antenna. For Approach Azimuth functions, increasing angle values shall be in the direction of the TO-scan. For the Back Azimuth function, increasing angle values shall be in the direction of the FRO-scan.

3.2.1.3.2.5 Elevation scanning convention.— Scanning conventions for elevation guidance signals shall be in accordance with Figure 6. Each angle guidance transmission shall consist of an upward TO-scan followed by a downward FRO-scan. The TO-scan shall be in the direction of increasing angle values. Zero elevation angle shall coincide with a horizontal plane through the antenna phase center.

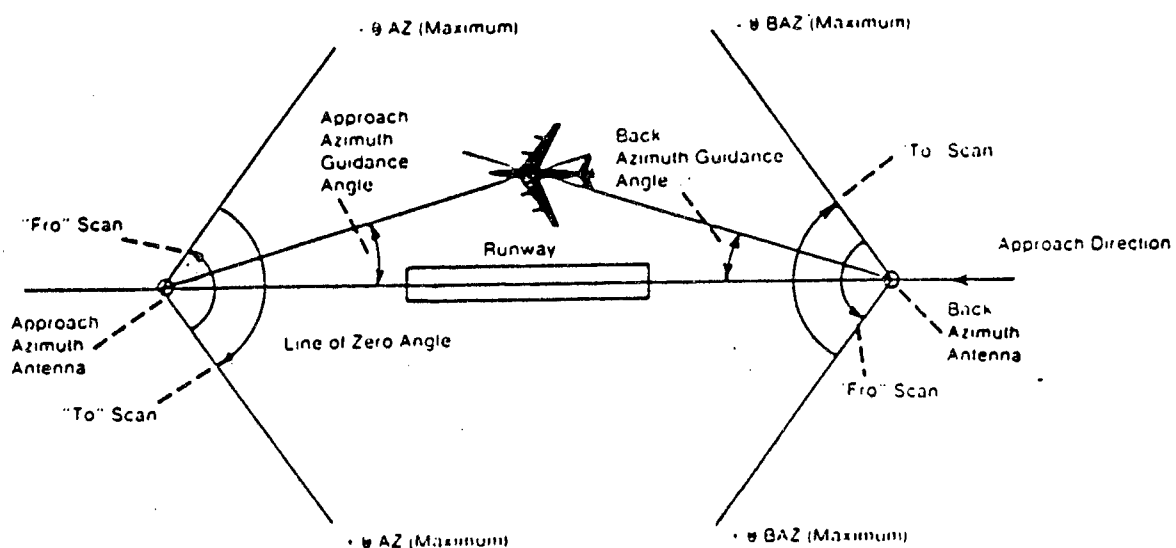
3.2.2 Data Functions.— Provision shall be made in the MLS signal format for the transmission of Basic Data and Auxiliary Data.

3.2.2.1 Data encoding

3.2.2.1.1 Differential phase shift keying (DPSK).— The preamble and other codes and the Basic and Auxiliary Data signals shall be transmitted by phase shift keying of the radio frequency carrier using differential coding. A "zero" shall be represented by a 0 degree plus or minus 10 degrees phase shift and a "one" shall be represented by a 180 degrees plus or minus 10 degrees phase shift.

3.2.2.2 Basic Data structure.— Basic Data shall be encoded as 32-bit words consisting of a function preamble (12 bits), data transmission (18 bits) and parity (2 bits) as specified in Figure 7. The preamble organization is the same as for the angle functions (3.2.1). Data containing digital information shall be transmitted Least Significant Bit first, and the smallest binary number shall represent the lower absolute range limit with increments in binary steps to the upper absolute range limit as specified in Table 6. The sign bit convention shall be as specified in Table 6.

Figure 5. Scanning Conventions for Azimuth Guidance Functions



**NOTE:** The Approach and Back Azimuth angles are negative for the position of the aircraft shown in Figure 5.



Figure 6. Scanning Conventions for Approach Elevation Guidance Functions

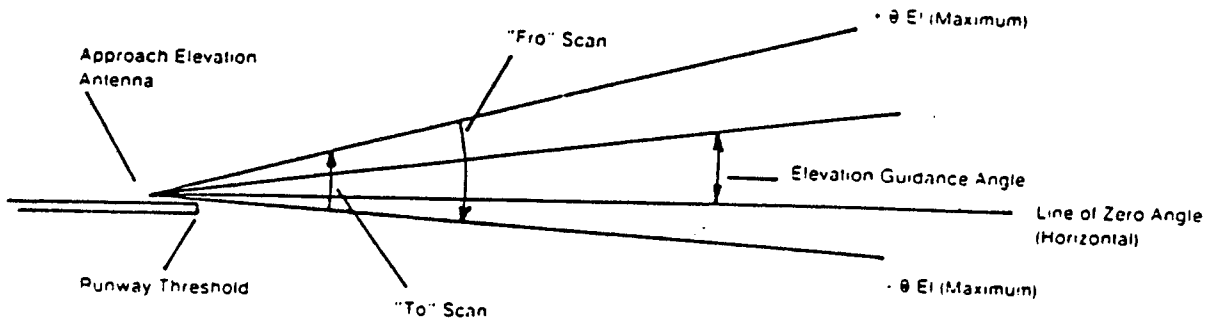


Figure 7. Basic Data Organization

|             | PREAMBLE<br>(I <sub>1</sub> -I <sub>12</sub> ) |    | DATA TRANSMISSION<br>(I <sub>13</sub> -I <sub>30</sub> ) |    | PARITY<br>(I <sub>31</sub> -I <sub>32</sub> ) |    |
|-------------|--|----|--|----|---|----|
| CLOCK PULSE | 0  | 24 | 25   | 42 | 43  | 44 |

**3.2.2.3 Auxiliary Data structure.**— Auxiliary Data shall be organized into 76-bit words consisting of a preamble, an address, information bits and parity bits as shown in Figure 8. Two Auxiliary Data word formats shall be provided, one for digital data and one for alphanumeric character data. Data containing digital information shall be transmitted with the least significant bit first. Alphanumeric data characters shall be encoded in accordance with a 7-unit (ASCII) Code character set, using seven information bits, plus one even parity bit added to each character. Alphanumeric data shall be transmitted in the order in which they are to be read. The serial transmission of a character shall be with the lower order bit transmitted first and the parity bit transmitted last. When provided, Auxiliary Data shall be transmitted between the function sequences and shall be preceded by a 12-bit preamble as specified in 3.2.1.1.

Figure 8. Auxiliary Data Word Organization

| <u>PREAMBLE</u>                 | <u>ADDRESS</u>                   | <u>DATA</u>                      | <u>PARITY</u>                    |
|---------------------------------|----------------------------------|----------------------------------|----------------------------------|
| I <sub>1</sub> -I <sub>12</sub> | I <sub>13</sub> -I <sub>20</sub> | I <sub>21</sub> -I <sub>69</sub> | I <sub>70</sub> -I <sub>76</sub> |
| <u>(a) Digital Data</u>         |                                  |                                  |                                  |

| <u>ASCII CHARACTERS</u>         |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                  |
|---------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| <u>PREAMBLE</u>                 | <u>ADDRESS</u>                   | <u>#1</u>                        | <u>#2</u>                        | <u>#3</u>                        | <u>#4</u>                        | <u>#5</u>                        | <u>#6</u>                        | <u>#7</u>                        |
| I <sub>1</sub> -I <sub>12</sub> | I <sub>13</sub> -I <sub>20</sub> | I <sub>21</sub> -I <sub>28</sub> | I <sub>29</sub> -I <sub>36</sub> | I <sub>37</sub> -I <sub>44</sub> | I <sub>45</sub> -I <sub>52</sub> | I <sub>53</sub> -I <sub>60</sub> | I <sub>61</sub> -I <sub>68</sub> | I <sub>69</sub> -I <sub>76</sub> |
| <u>(b) Alphanumeric Data</u>    |                                  |                                  |                                  |                                  |                                  |                                  |                                  |                                  |

3.2.3 Function rates.— Each function transmitted shall be repeated at the rates shown in Table 3.

Table 3. Function Rates

| <u>Function</u>            | <u>Average Rate (Hz) measured over any 10 second period</u> |
|----------------------------|---|
| APPROACH AZIMUTH           | $13 \pm 0.5$  |
| HIGH RATE APPROACH AZIMUTH | $39 \pm 1.5$  |
| BACK AZIMUTH               | $6.5 \pm 0.25$  |
| APPROACH ELEVATION         | $39 \pm 1.5$  |
| BASIC DATA                 | See Table 6   |
| AUXILIARY DATA             | See Table 8   |

NOTE: When the proportional guidance sector is not greater than  $\pm 40$  degrees and a need for flare elevation or other growth functions at that facility is not anticipated, the high rate azimuth function should be used.

3.2.4 Time Division Multiplex format.— Angle guidance and data functions shall be organized into time sequences and transmitted on a single radio frequency channel.

3.2.4.1 Randomized transmissions.— The time interval between repetitive transmissions of any one function shall be varied in a manner which provides protection from synchronous interference.

Each function transmission is an independent entity which can occur in any position in the TDM sequence (with the exception that Back Azimuth must be preceded by Basic Data word No. 2).

Some sequences which have demonstrated protection from synchronous interference and provide the transmission rates required are illustrated in Figure 9, 10, and 11. Care must be taken to assure sufficient de-correlation between consecutive samples of the same function.

Figure 9. Complete Multiplex Transmission Cycle

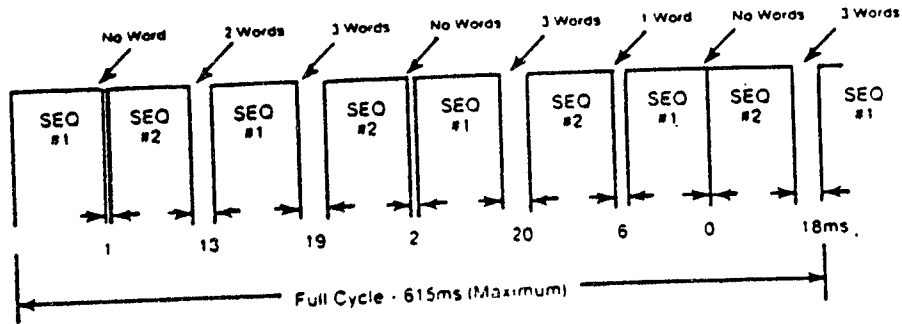


Figure 10. Transmission Sequence Pair Which Provides for all MLS Angle Guidance Functions

| Sequence #1        | Time (ms) | Sequence #2                  |
|--------------------|-----------|------------------------------|
| Approach Elevation | 0         | Approach Elevation           |
| Flare              | 10        | Flare                        |
| Approach Azimuth   | 20        | Approach Azimuth             |
| Flare              | 30        | Flare                        |
| Approach Elevation |           | Approach Elevation           |
| (Note 1)           |           |                              |
| Back Azimuth       | 50        | Growth (18.2ms Max) (Note 2) |
| (Note 2)           |           |                              |
| Approach Elevation | 60        | Approach Elevation           |
| Flare              | 66.7      | Flare                        |

(Note 3)

NOTES:

1. When Back Azimuth is provided Basic Data word #2 must be transmitted only in this position.
2. Data words may be transmitted in any open time periods.
3. The total time duration of sequence #1 plus sequence #2 must not exceed 134ms.

Figure 11. Transmission Sequence Pair Which Provides  
for the MLS High Rate Approach Azimuth  
Angle Guidance Function

| Sequence #1                      | Time<br>(ms) | Sequence #2                      |
|----------------------------------|--------------|----------------------------------|
| Approach<br>Elevation            | 0            | Approach<br>Elevation            |
| High Rate<br>Approach<br>Azimuth | 10           | High Rate<br>Approach<br>Azimuth |
| Data Words<br>(Note 1)           | 20           | (Note 2)                         |
| High Rate<br>Approach<br>Azimuth | 30           | Back<br>Azimuth                  |
| Approach<br>Elevation            |              | High Rate<br>Approach<br>Azimuth |
| High Rate<br>Approach<br>Azimuth | 50           | Approach<br>Elevation            |
| Approach<br>Elevation            | 60           | High Rate<br>Approach<br>Azimuth |
| Approach<br>Elevation            | 64.9         | Approach<br>Elevation            |
|                                  | 67.5         |                                  |

(Note 3)

NOTES:

1. Data words may be transmitted in any open time periods.
2. When Back Azimuth is provided, Basic Data word #2 must be transmitted only in this position.
3. The total time duration of sequence #1 plus sequence #2 must not exceed 134ms.

### 3.3 (Not used)

3.4 System coverage.— Azimuth, Elevation, range, and appropriate data signals shall be provided in the approach region to at least 20 nmi from the MLS datum point. For Systems with Approach Guidance Sectors wider than  $\pm 40$  degrees, coverage outside the  $\pm 40$ -degree sector shall be provided to at least 14 nmi from the MLS datum point. For autoland operation, Azimuth, range, and Data signals shall be provided near the runway surface. For missed approach or departure guidance, Back Azimuth and range signals shall be provided to at least 20 nmi from the MLS datum point. The system coverage for each function shall be provided under all operational weather conditions with a 95 percent probability.

NOTE: The angular coverage limits for each function are specified in 4.2.

3.4.1 Power densities-angle.— The power density for data, clearance pulses, and angle guidance signals, to satisfy the system coverage requirement, shall be at least equal to the values indicated in Table 4 (including NOTES 1 and 2).

Table 4. Minimum Power Density Within Coverage Boundaries (1) (3)  
(dBW/m<sup>2</sup>)

| <u>Function</u>            | <u>Data Signals</u> | <u>Angle Signals for Various Antenna Beamwidths (2)</u> |      |     |     | <u>Clearance Signals</u> |
|----------------------------|---------------------|---|------|-----|-----|--------------------------|
|                            |                     | 1°  | 1.5° | 2°  | 3°  |                          |
| Approach Azimuth           | -89                 | -78   | --   | -79 | --  | -86                      |
| High Rate Approach Azimuth | -89                 | -78   | --   | -79 | -80 | -86                      |
| Back Azimuth               | -89                 | -78   | --   | -79 | --  | -86                      |
| Approach Elevation         | -89                 | -84   | -85  | -86 | --  | --                       |

NOTE 1: In the approach region within  $\pm 10$  degrees azimuth of centerline, the power density shall exceed that given in Table 4 by 1.5 dB for data signals, 2 dB for azimuth signals and 6 dB for elevation signals. Below an elevation angle of  $1.8^\circ$  to the lower coverage limit, the power density for the elevation function may decrease linearly to -88 dBW/m<sup>2</sup>.

NOTE 2: In the runway region at the reference datum, the power density for each function shall be at least 15 dB higher than those indicated in the Table. The approach azimuth power density at 8 ft. above the runway surface should not be less than -70 dBW/m<sup>2</sup> for all antenna configurations. Where this is not possible due to siting, the lower limit of coverage to be published is that where the minimum power density requirements given in table 4 and the accuracy requirements are satisfied. This is not to imply a restrictive categorization if the diminished lower coverage does not impact meeting the operational requirements at that site.

NOTE 3: The specified values are chosen to limit receiver thermal noise to minimum obtainable values consistent with transmitter power levels less than 20 watts and antenna designs of moderate to high efficiencies.

3.5 System accuracies.— The system accuracies discussed in this paragraph and its sub-paragraphs concern only the angle system, except those in sub-paragraph 3.5.4 which relate to the DME/P. The system angle errors shall not exceed those listed in Table 5a at the appropriate reference datum when using airborne equipment that satisfies the requirements specified in RTCA DO-177, (i.e., for receivers with Electrical Output B). At the appropriate reference datum, temporal sinusoidal noise components shall not exceed 0.025 degree peak in the frequency band 0.01 Hz to 1.6 Hz, and the CMN shall not exceed 0.10 degree. The accuracy shall be measured in accordance with paragraph 6.

NOTE: The intent of the CMN performance requirements is to permit auto-coupled approaches from near the coverage limits using flight control systems typical of the existing air-carrier fleet. The intent of the PFE and PFN performance requirements is to minimize the touchdown dispersions and to place the aircraft in a satisfactory attitude at the reference datum.

### 3.5.1 (Not used).-

3.5.2 Accuracy degradation.- From the appropriate reference datum to the coverage limit, the PFE, PFN and CMN limits, expressed in angular terms, shall be allowed to linearly increase as follows:

#### (1) For the approach azimuth function:

- (a) With distance along the runway centerline extended, by a factor of 1.2 for the PFE and PFN limits and to  $\pm 0.10$  degree for the CMN limits.
- (b) With azimuth angle, by a factor of 1.5 at the  $\pm 40$  degree and a factor of 2.0 at the  $\pm 60$  degree azimuth angles for the PFE, PFN and CMN limits.
- (c) With elevation angle from  $+9$  degrees to  $+15$  degrees, by a factor of 1.5 for the PFE and PFN limits.
- (d) Maximum angular limits. The PFE limits shall not exceed  $\pm 0.25$  degree in any coverage region below an elevation angle of  $+9$  degrees nor exceed  $\pm 0.50$  degree in any coverage region above that elevation angle. The CMN limits shall not exceed  $\pm 0.10$  degree in any coverage region within  $\pm 10$  degrees of runway centerline extended nor exceed  $\pm 0.20$  degree in any other region within coverage.

NOTE: It is desirable that the CMN limits not exceed  $\pm 0.10$  degree throughout the coverage.

#### (2) For approach elevation functions:

- (a) With distance along the runway centerline extended at the minimum glide path angle, by a factor of 1.2 for the PFE and PFN limits and to  $\pm 0.10$  degree for the CMN limits.
- (b) With azimuth angle, from runway centerline extended to plus or minus 40 degrees, by a factor of 1.2 for the PFE and PFN limits and by a factor of 2.0 for CMN limits, with the limits remaining constant from 40 degrees to 60 degrees coverage extreme, if provided.
- (c) With increasing elevation angles from  $+3$  degrees to  $+15$  degrees, by a factor of 2.0 for the PFE and PFN limits.
- (d) With decreasing elevation angle from  $+3$  degrees (or 60% of the minimum glide path angle, whichever is less) to the coverage extreme, by a factor of 3 for the PFE, PFN and CMN limits.

- (e) Maximum angular limits. The CMN limits shall not exceed  $\pm 0.10$  degree in any coverage region within  $\pm 10$  degrees laterally of runway centerline extended which is above the elevation angle specified in (d) above.

NOTE: It is desirable that the CMN limits not exceed  $\pm 0.10$  degree throughout the coverage region above the elevation angle specified in (d) above.

(3) For the back azimuth function:

- (a) With distance along the runway centerline extended, by a factor of 1.2 for the PFE and PFN limits and to  $\pm 0.20$  degrees for the CMN limits.
- (b) With azimuth angle, by a factor of 1.5 at  $\pm 40$  degrees for the PFE, PFN, and CMN limits.
- (c) With elevation angle from  $+9$  degrees to  $+15$  degrees, by a factor of 1.5 for the PFE and PFN limits.
- (d) Maximum angular limits. The PFE limits shall not exceed  $\pm 0.25$  degrees in any coverage region below an elevation angle of  $+9$  degrees nor exceed  $\pm 0.50$  degrees in any coverage region above that elevation angle.

Note: It is desirable that the CMN limits not exceed  $\pm 0.20$  degrees throughout the coverage.

Table 5a. Angle System Error Limits at the Reference Datum

| <u>Function</u>       | <u>At Approach<br/>Reference Datum</u> |                   |                     | <u>At Back Azimuth<br/>Reference Datum</u> |                   |                     |
|-----------------------|--|-------------------|---------------------|--|-------------------|---------------------|
|                       | <u>PFN</u>                             | <u>PFE</u>        | <u>CMN</u>          | <u>PFN</u>                                 | <u>PFE</u>        | <u>CMN</u>          |
| Approach<br>Azimuth   | $\pm 11.5\text{ft}$                    | $\pm 20\text{ft}$ | $\pm 10.5\text{ft}$ | --   | --                | --                  |
| Approach<br>Elevation | $\pm 0.087^\circ$                      | $\pm 0.133^\circ$ | $\pm 0.050^\circ$   | --   | --                | --                  |
| Back Azimuth          | --                                     | --                | --                  | $\pm 11.5\text{ft}$                        | $\pm 20\text{ft}$ | $\pm 10.5\text{ft}$ |

3.5.3 Accuracy in the runway region.— The linear accuracies specified in Table 5a for the Approach Azimuth function shall be maintained throughout the runway coverage region specified in 4.2.2.2 except where degradation is allowed by 3.5.2(1).



**3.5.4 DME/P Accuracy.**— The DME/P accuracy standards specified herein shall be met on a 95 percent probability basis. These system limits include errors from all causes such as those from airborne equipment (for an interrogator that satisfies the requirements of RTCA/DO-189), ground equipment, propagation and random pulse interference effects.

Errors on the extended runway centerline shall not exceed the values given in Table 5b. In the approach sector, away from the extended runway centerline, the allowable PFE for the DME/P standard 1 shall be permitted to increase linearly with angle up to plus or minus 40 degrees MLS azimuth angle where the permitted error is 1.5 times that on the extended runway centerline at the same distance. The allowable CMN shall not increase with angle. There shall be no degradation of either PFE or CMN with elevation angle.

**Table 5b. Allowable DME/P Standard 1 System Errors**

| <u>LOCATION</u>  | <u>MODE</u> | <u>PFE</u>   | <u>CMN</u>  |
|--|-------------|--|---|
| 20 NM to 5NM<br>From MLS Approach<br>Reference Datum                     | IA          | +250 m (820 ft)<br>Reducing<br>Linearly to<br>+85 m (279 ft) | 68 m (223 ft)<br>Reducing<br>Linearly to<br>34 m (111 ft) |
| 5 NM to MLS Approach<br>Reference Datum                                  | FA          | +85 m (279 ft)<br>Reducing Linearly<br>to +30 m (100 ft)     | 18 m (60 ft)  |
| See Note (2)   | IA          | +100 m (328 ft)  | 68 m (223 ft)   |
| At MLS Approach Refer-<br>ence Datum and through-<br>out Runway Coverage | FA          | +30 m (100 ft)   | 18 m (60 ft)  |
| 5NM to Back Azimuth<br>Reference Datum                                   | IA/FA       | +100 m (328 ft)  | 68 m (223 ft)   |
| 20 NM to 5NM From<br>Back Azimuth Reference<br>Linearly<br>Datum<br>ft)  | IA          | +250 m (820 ft)<br>Reducing Linearly<br>to +100m (328 ft)    | 68 m (223 ft)<br>Reducing<br>to 34m (111                  |

- Note:**
- (1) Outside the Approach Azimuth and Back Azimuth coverage sectors the PFE shall not exceed +375m (1230 ft) and the CMN shall not exceed 68m (223 ft).
  - (2) At distances from 5 nautical miles to the MLS approach reference datum and throughout the back azimuth coverage, the IA mode may be used when the FA mode is not operative.

3.6 Basic Data content.- Basic Data shall consist of the items specified in Table 6. Basic Data words shall be defined as follows:

- (a) Approach azimuth to threshold distance shall represent the minimum distance between the approach azimuth antenna phase center and the vertical plane perpendicular to the centerline which contains the runway landing threshold.
- (b) Approach azimuth proportional coverage limit shall represent the limit of the sector in which proportional Approach Azimuth guidance is transmitted.

NOTE: This limit does not represent the angle of the maximum flyable azimuth course. That will always be an angle less than the proportional limit and should be determined by flight inspection.

- (c) Clearance signal type shall indicate the method of providing the azimuth clearance signal.
- (d) Minimum glide path shall represent the minimum glide path as defined in 1.5.20.
- (e) Back azimuth status shall represent the operational status of the Back Azimuth equipment.
- (f) DME status shall represent the operational status of the DME equipment.
- (g) Approach azimuth status shall represent the operational status of the Approach Azimuth equipment.
- (h) Approach elevation status shall represent the operational status of the Approach Elevation equipment.
- (i) Beamwidth shall represent, for a particular function, the antenna beamwidth as defined in 1.5.7.
- (j) DME distance shall represent the minimum distance between the DME antenna phase center and the vertical plane perpendicular to the runway center line which contains the MLS datum point.
- (k) Approach azimuth magnetic orientation shall represent the angle measured in the horizontal plane clockwise from Magnetic North to the zero-degree angle guidance radial of the Approach Azimuth antenna. The vertex of the measured angle shall be at the Approach Azimuth antenna phase center.

NOTE: For example, this data item would be encoded 090 for an approach Azimuth antenna serving runway 27, (assuming the magnetic heading is 270 degrees), when sited such that the zero degree radial is parallel to centerline.

- (l) Back azimuth magnetic orientation shall represent the angle measured in the horizontal plane clockwise from Magnetic North to the zero-degree angle guidance radial of the Back Azimuth antenna. The vertex of the measured angle shall be at the Back Azimuth antenna phase center.

NOTE: For example, this data item would be encoded 270 for a Back Azimuth Antenna serving runway 27, (assuming the magnetic heading is 270 degrees), when sited such that the zero degree radial is parallel to centerline.

- (m) Back azimuth proportional coverage limit shall represent the limit of the sector in which proportional Back Azimuth guidance is transmitted. This limit does not represent the angle of the maximum flyable azimuth course. That will always be an angle less than the proportional limit and should be determined by flight inspection.
- (n) MLS ground equipment identification shall represent the three characters of the system identification. The characters shall be encoded in accordance with the International Alphabet No. 5 (IA-5) using bits B<sub>1</sub> through B<sub>6</sub>.

NOTE: Bit B<sub>7</sub> of this code may be reconstructed in the airborne receiver by taking the complement of bit B<sub>6</sub>.

Table 6. Basic Data WordsBASIC DATA WORD #1

| <u>DATA<br/>BIT #</u> | <u>DATA ITEM DEFINITION</u>   | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
|-----------------------|---|----------------------|---------------------------|
| 1                     | Preamble (See Note 8)   | N/A                  | 1                         |
| 2                     |   |                      | 1                         |
| 3                     |   |                      | 1                         |
| 4                     |   |                      | 0                         |
| 5                     |   |                      | 1                         |
| 6                     |   |                      | 0                         |
| 7                     |   |                      | 1                         |
| 8                     |   |                      | 0                         |
| 9                     |   |                      | 1                         |
| 10                    |   |                      | 0                         |
| 11                    |   |                      | 0                         |
| 12                    |   |                      | 0                         |
| 13                    | Approach azimuth to threshold distance<br>(0m - 6300m)  | 100m                 | 100m                      |
| 14                    |   |                      | 200m                      |
| 15                    |   |                      | 400m                      |
| 16                    |   |                      | 800m                      |
| 17                    |   |                      | 1600m                     |
| 18                    |   |                      | 3200m                     |
| 19                    | Approach azimuth proportional coverage<br>limit (negative limit)<br>(0° to -60°) (See Note 9) | 2°                   | -2°                       |
| 20                    |   |                      | -4°                       |
| 21                    |   |                      | -8°                       |
| 22                    |   |                      | -16°                      |
| 23                    |   |                      | -32°                      |
| 24                    | Approach azimuth proportional coverage<br>limit (positive limit)<br>(0° to +60°) (See Note 9) | 2°                   | 2°                        |
| 25                    |   |                      | 4°                        |
| 26                    |   |                      | 8°                        |
| 27                    |   |                      | 16°                       |
| 28                    |   |                      | 32°                       |
| 29                    | Clearance signal type   | N/A                  | 0 = pulse;<br>1 = SB      |
| 30                    | Spare   |                      | Transmit<br>zero          |
| 31                    | Parity: (13+14+15...+30+31 = ODD)   | N/A                  | N/A                       |
| 32                    | Parity: (14+16+18...+30+32 = ODD)   | N/A                  | N/A                       |

Table 6. Basic Data Words (cont.)

| <u>BASIC DATA WORD #2</u> |                                       |                      |                           |
|---------------------------|---------------------------------------|----------------------|---------------------------|
| <u>DATA<br/>BIT #</u>     | <u>DATA ITEM DEFINITION</u>           | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
| 1                         | Preamble (See Note 8)                 | N/A                  | 1                         |
| 2                         |                                       |                      | 1                         |
| 3                         |                                       |                      | 1                         |
| 4                         |                                       |                      | 0                         |
| 5                         |                                       |                      | 1                         |
| 6                         |                                       |                      | 0                         |
| 7                         |                                       |                      | 1                         |
| 8                         |                                       |                      | 1                         |
| 9                         |                                       |                      | 1                         |
| 10                        |                                       |                      | 1                         |
| 11                        |                                       |                      | 0                         |
| 12                        |                                       |                      | 0                         |
| 13                        | Minimum glide path<br>(2.0° to 14.7°) | 0.1°                 | 0.1°                      |
| 14                        |                                       |                      | 0.2°                      |
| 15                        |                                       |                      | 0.4°                      |
| 16                        |                                       |                      | 0.8°                      |
| 17                        |                                       |                      | 1.6°                      |
| 18                        |                                       |                      | 3.2°                      |
| 19                        |                                       |                      | 6.4°                      |
| 20                        | Back azimuth status                   |                      | see note 4                |
| 21                        | DME status                            |                      | see note 6                |
| 22                        |                                       |                      |                           |
| 23                        | Approach azimuth status               |                      | see note 4                |
| 24                        | Approach elevation status             |                      | see note 4                |
| 25                        | Spare                                 |                      | Transmit zero             |
| 26                        | Spare                                 |                      | Transmit zero             |
| 27                        | Spare                                 |                      | Transmit zero             |
| 28                        | Spare                                 |                      | Transmit zero             |
| 29                        | Spare                                 |                      | Transmit zero             |
| 30                        | Spare                                 |                      | Transmit zero             |
| 31                        | Parity: (13+14+15...+30+31 = ODD)     | N/A                  | N/A                       |
| 32                        | Parity: (14+16+18...+30+32 = ODD)     | N/A                  | N/A                       |

Table 6. Basic Data Words (cont.)

BASIC DATA WORD #3

| <u>DATA<br/>BIT #</u> | <u>DATA ITEM DEFINITION</u>  | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
|-----------------------|--|----------------------|---------------------------|
| 1                     | Preamble (See Note 8)  | N/A                  | 1                         |
| 2                     |  |                      | 1                         |
| 3                     |  |                      | 1                         |
| 4                     |  |                      | 0                         |
| 5                     |  |                      | 1                         |
| 6                     |  |                      | 1                         |
| 7                     |  |                      | 0                         |
| 8                     |  |                      | 1                         |
| 9                     |  |                      | 0                         |
| 10                    |  |                      | 0                         |
| 11                    |  |                      | 0                         |
| 12                    |  |                      | 0                         |
| 13                    | Approach azimuth beamwidth<br>(0.5° - 4.0°) (See note 7)   | 0.5°                 | 0.5°                      |
| 14                    |  |                      | 1.0°                      |
| 15                    |  |                      | 2.0°                      |
| 16                    | Approach elevation beamwidth<br>(0.5° to 2.5°) (See note 7)<br>Note: values greater than 2.5°<br>are invalid | 0.5°                 | 0.5°                      |
| 17                    |  |                      | 1.0°                      |
| 18                    |  |                      | 2.0°                      |
| 19                    | DME distance<br>(0m to 6387.5m)  | 12.5m                | 12.5m                     |
| 20                    |  |                      | 25.0m                     |
| 21                    |  |                      | 50.0m                     |
| 22                    |  |                      | 100.0m                    |
| 23                    |  |                      | 200.0m                    |
| 24                    |  |                      | 400.0m                    |
| 25                    |  |                      | 800.0m                    |
| 26                    |  |                      | 1600.0m                   |
| 27                    |  |                      | 3200.0m                   |
| 28                    | Spare  |                      | Transmit zero             |
| 29                    | Spare  |                      | Transmit zero             |
| 30                    | Spare  |                      | Transmit zero             |
| 31                    | Parity: (13+14+15...+30+31 = ODD)  | N/A                  | N/A                       |
| 32                    | Parity: (14+16+18...+30+32 = ODD)  |                      |                           |

Table 6. Basic Data Words (cont.)BASIC DATA WORD #4

| <u>DATA<br/>BIT #</u> | <u>DATA ITEM DEFINITION</u>                              | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
|-----------------------|--|----------------------|---------------------------|
| 1                     | Preamble (See Note 8)                                    | N/A                  | 1                         |
| 2                     |  |                      | 1                         |
| 3                     |  |                      | 1                         |
| 4                     |  |                      | 0                         |
| 5                     |  |                      | 1                         |
| 6                     |  |                      | 1                         |
| 7                     |  |                      | 0                         |
| 8                     |  |                      | 0                         |
| 9                     |  |                      | 0                         |
| 10                    |  |                      | 1                         |
| 11                    |  |                      | 0                         |
| 12                    |  |                      | 0                         |
| 13                    | Approach azimuth magnetic<br>orientation<br>(0° to 359°) | 1°                   | 1°                        |
| 14                    |  |                      | 2°                        |
| 15                    |  |                      | 4°                        |
| 16                    |  |                      | 8°                        |
| 17                    |  |                      | 16°                       |
| 18                    |  |                      | 32°                       |
| 19                    |  |                      | 64°                       |
| 20                    |  |                      | 128°                      |
| 21                    |  |                      | 256°                      |
| 22                    | Back azimuth magnetic<br>orientation<br>(0° to 359°)     | 1°                   | 1°                        |
| 23                    |  |                      | 2°                        |
| 24                    |  |                      | 4°                        |
| 25                    |  |                      | 8°                        |
| 26                    |  |                      | 16°                       |
| 27                    |  |                      | 32°                       |
| 28                    |  |                      | 64°                       |
| 29                    |  |                      | 128°                      |
| 30                    |  |                      | 256°                      |
| 31                    | Parity: (13+14+15...+30+31 = ODD)                        | N/A                  | N/A                       |
| 32                    | Parity: (14+16+18...+30+32 = ODD)                        | N/A                  | N/A                       |

Table 6. Basic Data Words (cont.)

| <u>BASIC DATA WORD #5</u> |   |                      |                           |
|---------------------------|---|----------------------|---------------------------|
| <u>DATA<br/>BIT #</u>     | <u>DATA ITEM DEFINITION</u>   | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
| 1                         | Preamble (See Note 8)   | N/A                  | 1                         |
| 2                         |   |                      | 1                         |
| 3                         |   |                      | 1                         |
| 4                         |   |                      | 0                         |
| 5                         |   |                      | 1                         |
| 6                         |   |                      | 1                         |
| 7                         |   |                      | 1                         |
| 8                         |   |                      | 0                         |
| 9                         |   |                      | 1                         |
| 10                        |   |                      | 1                         |
| 11                        |   |                      | 0                         |
| 12                        |   |                      | 0                         |
| 13                        | Back azimuth proportional<br>coverage negative limit<br>(0° to -40°) (See Note 9) | 2°                   | -2°                       |
| 14                        |   |                      | -4°                       |
| 15                        |   |                      | -8°                       |
| 16                        |   |                      | -16°                      |
| 17                        |   |                      | -32°                      |
| 18                        | Back azimuth proportional<br>coverage positive limit<br>(0° to +40°) (See Note 9) | 2°                   | 2°                        |
| 19                        |   |                      | 4°                        |
| 20                        |   |                      | 8°                        |
| 21                        |   |                      | 16°                       |
| 22                        |   |                      | 32°                       |
| 23                        | Back azimuth beamwidth<br>(0.5° to 4.0°) (See note 7)                             | 0.5°                 | 0.5°                      |
| 24                        |   |                      | 1.0°                      |
| 25                        |   |                      | 2.0°                      |
| 26                        | Back Azimuth Status   |                      | See Note 10               |
| 27                        | Spare   |                      | Transmit zero             |
| 28                        | Spare   |                      | Transmit zero             |
| 29                        | Spare   |                      | Transmit zero             |
| 30                        | Spare   |                      | Transmit zero             |
| 31                        | Parity: (13+14+15...+30+31 = ODD)   | N/A                  | N/A                       |
| 32                        | Parity: (14+16+18...+30+32 = ODD)   | N/A                  | N/A                       |



Table 6. Basic Data Words (cont.)

| <u>BASIC DATA WORD #6</u> |  |                      |                           |
|---------------------------|--|----------------------|---------------------------|
| <u>DATA<br/>BIT #</u>     | <u>DATA ITEM DEFINITION</u>                  | <u>LSB<br/>VALUE</u> | <u>DATA BIT<br/>VALUE</u> |
| 1                         | Preamble (See Note 8)                        | N/A                  | 1                         |
| 2                         |  |                      | 1                         |
| 3                         |  |                      | 1                         |
| 4                         |  |                      | 0                         |
| 5                         |  |                      | 1                         |
| 6                         |  |                      | 0                         |
| 7                         |  |                      | 0                         |
| 8                         |  |                      | 0                         |
| 9                         |  |                      | 1                         |
| 10                        |  |                      | 1                         |
| 11                        |  |                      | 0                         |
| 12                        |  |                      | 1                         |
| (13 - 30)                 | MLS ground equipment identification (Note 3) |                      |                           |
| 13                        | Character 2                                  | N/A                  | B1                        |
| 14                        |  |                      | B2                        |
| 15                        |  |                      | B3                        |
| 16                        |  |                      | B4                        |
| 17                        |  |                      | B5                        |
| 18                        |  |                      | B6                        |
| 19                        | Character 3                                  | N/A                  | B1                        |
| 20                        |  |                      | B2                        |
| 21                        |  |                      | B3                        |
| 22                        |  |                      | B4                        |
| 23                        |  |                      | B5                        |
| 24                        |  |                      | B6                        |
| 25                        | Character 4                                  | N/A                  | B1                        |
| 26                        |  |                      | B2                        |
| 27                        |  |                      | B3                        |
| 28                        |  |                      | B4                        |
| 29                        |  |                      | B5                        |
| 30                        |  |                      | B6                        |
| 31                        | Parity: (13+14+15...+30+31 = ODD)            | N/A                  | N/A                       |
| 32                        | Parity: (14+16+18...+30+32 = ODD)            | N/A                  | N/A                       |

Table 6. Basic Data Words (cont.)

NOTE 1: The Basic Data Words shall be transmitted throughout the appropriate guidance sectors at minimum average rates (measured over a 10 second period) indicated below.

| Word | Transmission Rates (Hertz) |                     |         |
|------|----------------------------|---------------------|---------|
|      | App. Az only               | If Back Az Provided |         |
|      | App. Az                    | App. Az             | Back Az |
| 1    | 1.0                        | 1.0                 | N/A     |
| 2    | 6.5                        | 6.5                 | N/A     |
| 3    | 1.0                        | 1.0                 | N/A     |
| 4    | 1.0                        | 0.75                | 0.25    |
| 5    | N/A                        | 0.25                | 0.75    |
| 6    | 1.0                        | 0.75                | 0.25    |

NOTE 2: The all zero state of the data field represents the lower limit of the absolute range of the coded parameter unless otherwise noted.

NOTE 3: Characters are encoded using the International Alphabet Number 5 (IA-5), bits B<sub>1</sub> through B<sub>6</sub>.

NOTE 4: Coding for status bit:

- 0 = Function not radiated, or radiated in test mode (not reliable for navigation).
- 1 = Function radiated in normal mode (for system with Back Azimuth, this also indicates that a Back Azimuth transmission follows).

NOTE 5: Data items which are not applicable to a particular ground equipment shall be transmitted as all zeros.

NOTE 6: Coding for status bits:

| I <sub>21</sub> | I <sub>22</sub> |   |
|-----------------|-----------------|---|
| 0               | 0               | DME transponder inoperative or not available. |
| 1               | 0               | Only IA mode or DME/N available.              |
| 0               | 1               | FA mode, Standard 1, available.               |
| 1               | 1               | FA mode, Standard 2, available.               |

NOTE 7: The value coded shall be the actual beamwidth (as defined in 1.5.7) rounded to the nearest 0.5°.

NOTE 8: The 12 data bits of the preamble are preceded by a 0.832 millisecond interval (13 clock pulses) of CW for carrier acquisition (See Table 19).

NOTE 9: The scan limits will be greater than the proportional coverage limits as described 3.2.1.3.2.2.

NOTE 10: Coding for status bit:

- 0 = Function not radiated, or radiated in test mode (not reliable for navigation).
- 1 = Function radiated in normal mode.

### 3.7 Auxiliary data.

3.7.1 Addresses.— The address codes of the auxiliary data words shall be as shown in Table 7.

3.7.2 Content.— Three function identification codes are reserved to indicate transmission of Auxiliary Data A, Auxiliary Data B and Auxiliary Data C. Auxiliary Data A contents that have been defined shall be specified below, Auxiliary Data B contents shall be reserved for future use, and Auxiliary Data C contents shall be reserved for national use.

3.7.2.1 Auxiliary data A content.— The data items specified in Table 8 are defined as follows:

- (a) Approach azimuth antenna offset shall represent the minimum distance between the Approach Azimuth antenna phase center and the vertical plane containing the runway centerline.
- (b) Approach azimuth to MLS datum point distance shall represent the minimum distance between the Approach Azimuth antenna phase center and the vertical plane perpendicular to the centerline which contains the MLS datum point.
- (c) Approach azimuth alignment with runway center line shall represent minimum angle between the Approach Azimuth antenna zero-degree guidance plane and the runway center line.
- (d) Approach azimuth antenna coordinate system shall represent the coordinate system (planar or conical) of the angle data transmitted by the Approach Azimuth antenna.
- (e) Approach elevation antenna offset shall represent the minimum distance between the Elevation antenna phase center and the vertical plane containing the runway centerline.
- (f) MLS datum point to threshold distance shall represent the distance measured along the runway centerline from the MLS datum point to the runway threshold.
- (g) Approach elevation antenna height shall represent the height of the Elevation antenna phase center relative to the height of the MLS datum point.
- (h) DME offset shall represent the minimum distance between the DME antenna phase center and the vertical plane containing the runway centerline.
- (i) DME to MLS datum point distance shall represent the minimum distance between the DME antenna phase center and the vertical plane perpendicular to the centerline which contains the MLS datum point.

- (j) Back azimuth antenna offset shall represent the minimum distance between the Back Azimuth antenna phase center and the vertical plane containing the runway centerline.
- (k) Back azimuth to MLS datum point distance shall represent the minimum distance between the Back Azimuth antenna and the vertical plane perpendicular to the centerline which contains the MLS datum point.
- (l) Back azimuth antenna alignment with runway centerline shall represent the minimum angle between the Back Azimuth antenna zero-degree guidance plane and the runway centerline.
- (m) Approach azimuth antenna height shall represent the vertical location of the antenna phase center with respect to the MLS datum point.
- (n) MLS datum point elevation shall represent the datum point elevation relative to mean sea level (msl).
- (o) Runway threshold height shall represent the vertical location of the intersection of the runway threshold and centerline with respect to the MLS datum point.
- (p) DME antenna height shall represent the vertical location of the antenna phase center with respect to the MLS datum point.
- (q) Runway stop-end distance shall represent the distance along centerline between the runway stop-end and the MLS datum point.
- (r) Back azimuth antenna coordinate system shall represent the coordinate system (planar or conical) of the angle data transmitted by the Back Azimuth antenna.
- (s) Back azimuth height shall represent the vertical location of the antenna phase center with respect to the MLS datum point.
- (t) Runway visual range (RVR) shall represent measurement of instrument RVR at touchdown zone, midpoint, and stop end of the runway and trend values.
- (u) Surface wind shall represent wind speed and direction (magnetic).

3.7.3 (Not used)

TABLE 7. Auxiliary Data Word Address Codes

| No. | I <sub>13</sub> | I <sub>14</sub> | I <sub>15</sub> | I <sub>16</sub> | I <sub>17</sub> | I <sub>18</sub> | I <sub>19</sub> | I <sub>20</sub> | No. | I <sub>13</sub> | I <sub>14</sub> | I <sub>15</sub> | I <sub>16</sub> | I <sub>17</sub> | I <sub>18</sub> | I <sub>19</sub> | I <sub>20</sub> |
|-----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 1.  | 0               | 0               | 0               | 0               | 0               | 1               | 1               | 1               | 33. | 1               | 0               | 0               | 0               | 0               | 1               | 0               | 1               |
| 2.  | 0               | 0               | 0               | 0               | 1               | 0               | 1               | 0               | 34. | 1               | 0               | 0               | 0               | 1               | 0               | 0               | 0               |
| 3.  | 0               | 0               | 0               | 0               | 1               | 1               | 0               | 1               | 35. | 1               | 0               | 0               | 0               | 1               | 1               | 1               | 1               |
| 4.  | 0               | 0               | 0               | 1               | 0               | 0               | 1               | 1               | 36. | 1               | 0               | 0               | 1               | 0               | 0               | 0               | 1               |
| 5.  | 0               | 0               | 0               | 1               | 0               | 1               | 0               | 0               | 37. | 1               | 0               | 0               | 1               | 0               | 1               | 1               | 0               |
| 6.  | 0               | 0               | 0               | 1               | 1               | 0               | 0               | 1               | 38. | 1               | 0               | 0               | 1               | 1               | 0               | 1               | 1               |
| 7.  | 0               | 0               | 0               | 1               | 1               | 1               | 1               | 0               | 39. | 1               | 0               | 0               | 1               | 1               | 1               | 0               | 0               |
| 8.  | 0               | 0               | 1               | 0               | 0               | 0               | 1               | 0               | 40. | 1               | 0               | 1               | 0               | 0               | 0               | 0               | 0               |
| 9.  | 0               | 0               | 1               | 0               | 0               | 1               | 0               | 1               | 41. | 1               | 0               | 1               | 0               | 0               | 1               | 1               | 1               |
| 10. | 0               | 0               | 1               | 0               | 1               | 0               | 0               | 0               | 42. | 1               | 0               | 1               | 0               | 1               | 0               | 1               | 0               |
| 11. | 0               | 0               | 1               | 0               | 1               | 1               | 1               | 1               | 43. | 1               | 0               | 1               | 0               | 1               | 1               | 0               | 1               |
| 12. | 0               | 0               | 1               | 1               | 0               | 0               | 0               | 1               | 44. | 1               | 0               | 1               | 1               | 0               | 0               | 1               | 1               |
| 13. | 0               | 0               | 1               | 1               | 0               | 1               | 1               | 0               | 45. | 1               | 0               | 1               | 1               | 0               | 1               | 0               | 0               |
| 14. | 0               | 0               | 1               | 1               | 1               | 0               | 1               | 1               | 46. | 1               | 0               | 1               | 1               | 1               | 0               | 0               | 1               |
| 15. | 0               | 0               | 1               | 1               | 1               | 1               | 0               | 0               | 47. | 1               | 0               | 1               | 1               | 1               | 1               | 1               | 0               |
| 16. | 0               | 1               | 0               | 0               | 0               | 0               | 1               | 1               | 48. | 1               | 1               | 0               | 0               | 0               | 0               | 0               | 1               |
| 17. | 0               | 1               | 0               | 0               | 0               | 1               | 0               | 0               | 49. | 1               | 1               | 0               | 0               | 0               | 1               | 1               | 0               |
| 18. | 0               | 1               | 0               | 0               | 1               | 0               | 0               | 1               | 50. | 1               | 1               | 0               | 0               | 1               | 0               | 1               | 1               |
| 19. | 0               | 1               | 0               | 0               | 1               | 1               | 1               | 0               | 51. | 1               | 1               | 0               | 0               | 1               | 1               | 0               | 0               |
| 20. | 0               | 1               | 0               | 1               | 0               | 0               | 0               | 0               | 52. | 1               | 1               | 0               | 1               | 0               | 0               | 1               | 0               |
| 21. | 0               | 1               | 0               | 1               | 0               | 1               | 1               | 1               | 53. | 1               | 1               | 0               | 1               | 0               | 1               | 0               | 1               |
| 22. | 0               | 1               | 0               | 1               | 1               | 0               | 1               | 0               | 54. | 1               | 1               | 0               | 1               | 1               | 0               | 0               | 0               |
| 23. | 0               | 1               | 0               | 1               | 1               | 1               | 0               | 1               | 55. | 1               | 1               | 0               | 1               | 1               | 1               | 1               | 1               |
| 24. | 0               | 1               | 1               | 0               | 0               | 0               | 0               | 1               | 56. | 1               | 1               | 1               | 0               | 0               | 0               | 1               | 1               |
| 25. | 0               | 1               | 1               | 0               | 0               | 1               | 1               | 0               | 57. | 1               | 1               | 1               | 0               | 0               | 1               | 0               | 0               |
| 26. | 0               | 1               | 1               | 0               | 1               | 0               | 1               | 1               | 58. | 1               | 1               | 1               | 0               | 1               | 0               | 0               | 1               |
| 27. | 0               | 1               | 1               | 0               | 1               | 1               | 0               | 0               | 59. | 1               | 1               | 1               | 0               | 1               | 1               | 1               | 0               |
| 28. | 0               | 1               | 1               | 1               | 0               | 0               | 1               | 0               | 60. | 1               | 1               | 1               | 1               | 0               | 0               | 0               | 0               |
| 29. | 0               | 1               | 1               | 1               | 0               | 1               | 0               | 1               | 61. | 1               | 1               | 1               | 1               | 0               | 1               | 1               | 1               |
| 30. | 0               | 1               | 1               | 1               | 1               | 0               | 0               | 0               | 62. | 1               | 1               | 1               | 1               | 1               | 0               | 1               | 0               |
| 31. | 0               | 1               | 1               | 1               | 1               | 1               | 1               | 1               | 63. | 1               | 1               | 1               | 1               | 1               | 1               | 0               | 1               |
| 32. | 1               | 0               | 0               | 0               | 0               | 0               | 1               | 0               | 64. | 0               | 0               | 0               | 0               | 0               | 0               | 0               | 0               |

NOTE 1.

Parity bits I<sub>19</sub> and I<sub>20</sub> are chosen to satisfy the equations:

$$I_{13} + I_{14} + I_{15} + I_{16} + I_{17} + I_{18} + I_{19} = \text{EVEN}$$

$$I_{14} + I_{16} + I_{18} + I_{20} = \text{EVEN}$$

Table 8. Auxiliary Data

| <u>Word<br/>(See<br/>Note 5)</u> | <u>Data Content</u>  | <u>Type<br/>of<br/>Data</u> | <u>Bits<br/>Used</u> | <u>Range<br/>Of<br/>Values</u>    | <u>Least<br/>Significant<br/>Bit</u> |
|----------------------------------|--|-----------------------------|----------------------|-----------------------------------|--------------------------------------|
| A1                               | Preamble   | digital                     | 12                   |                                   |                                      |
|                                  | Address  |                             | 8                    |                                   |                                      |
|                                  | Approach azimuth<br>antenna offset                                     |                             | 10                   | -511 m to +511m<br>(see Note 3)   | 1 m                                  |
|                                  | Approach azimuth<br>to MLS datum<br>point distance                     |                             | 13                   | 0 m to 8 191 m                    | 1 m                                  |
|                                  | Approach azimuth<br>antenna align-<br>ment with run-<br>way centerline |                             | 12                   | -20.47° to 20.47°<br>(see Note 3) | 0.01°                                |
|                                  | Approach azimuth<br>antenna coordi-<br>nate system                     |                             | 1                    | (see Note 2)                      |                                      |
|                                  | Approach azimuth<br>antenna height                                     |                             | 7                    | -63 m to +63 m<br>(see Note 3)    | 1 m                                  |
|                                  | spare  |                             | 6                    |                                   |                                      |
|                                  | Parity   |                             | 7                    | (see Note 1)                      |                                      |

Table 8. Auxiliary Data (Cont'd)

| <u>Word<br/>(See<br/>Note 5)</u> | <u>Data Content</u>                   | <u>Type<br/>of<br/>Data</u> | <u>Bits<br/>Used</u> | <u>Range<br/>Of<br/>Values</u>   | <u>Least<br/>Significant<br/>Bit</u> |
|----------------------------------|---------------------------------------|-----------------------------|----------------------|----------------------------------|--------------------------------------|
| A2                               | Preamble                              | digital                     | 12                   |                                  |                                      |
|                                  | Address                               |                             | 8                    |                                  |                                      |
|                                  | Approach elevation antenna offset     |                             | 10                   | -511 m to +511 m<br>(See Note 3) | 1 m                                  |
|                                  | MLS datum point to threshold distance |                             | 10                   | 0 m to 1 023 m                   | 1 m                                  |
|                                  | Approach elevation antenna height     |                             | 7                    | -6.3 m to +6.3 m<br>(See Note 3) | 0.1 m                                |
|                                  | MLS datum point elevation             |                             | 13                   | -4,095 m to +4,094 m             | 1 m                                  |
|                                  | Runway threshold height               |                             | 7                    | -6.3 m to +6.3 m<br>(see Note 3) | 0.1 m                                |
|                                  | Spare                                 |                             | 2                    |                                  |                                      |
|                                  | Parity                                |                             | 7                    | (See Note 1)                     |                                      |

Table 8. Auxiliary Data (Cont'd)

| <u>Word<br/>(See<br/>Note 5)</u> | <u>Data Content</u>                   | <u>Type<br/>of<br/>Data</u> | <u>Bits<br/>Used</u> | <u>Range<br/>Of<br/>Values</u>            | <u>Least<br/>Significant<br/>Bit</u> |
|----------------------------------|---------------------------------------|-----------------------------|----------------------|---|--------------------------------------|
| A3                               | Preamble                              | digital (See Note 4)        | 12                   |   |                                      |
|                                  | Address                               |                             | 8                    |   |                                      |
|                                  | DME offset                            |                             | 12                   | -2047 m to<br>+2074 m                     | 1 m                                  |
|                                  | DME to MLS<br>datum point<br>distance |                             | 14                   | -8, 191 m to<br>+8, 191 m<br>(See Note 3) | 1 m                                  |
|                                  | DME antenna<br>height                 |                             | 7                    | -63 m to +63 m<br>(see Note 3)            | 1 m                                  |
|                                  | Runway stop<br>end distance           |                             | 14                   | 0 m to 16,383 m                           | 1 m                                  |
|                                  | Spare                                 |                             | 2                    |   |                                      |
|                                  | Parity                                |                             | 7                    | (See Note 1)                              |                                      |



Table 8. Auxiliary Data (Cont'd)

| <u>Word<br/>(See<br/>Note 5)</u> | <u>Data Content</u>  | <u>Type<br/>of<br/>Data</u> | <u>Bits<br/>Used</u> | <u>Range<br/>Of<br/>Values</u>    | <u>Least<br/>Significant<br/>Bit</u> |
|----------------------------------|--|-----------------------------|----------------------|-----------------------------------|--------------------------------------|
| A4                               | Preamble   | digital                     | 12                   |                                   |                                      |
|                                  | Address  |                             | 8                    |                                   |                                      |
|                                  | Back azimuth<br>antenna offset                                     |                             | 10                   | -511 m to +511 m<br>(See Note 3)  | 1 m                                  |
|                                  | Back azimuth<br>to MLS datum<br>point distance                     |                             | 11                   | 0 m to 2,047 m                    | 1 m                                  |
|                                  | Back azimuth<br>antenna align-<br>ment with run-<br>way centerline |                             | 12                   | -20.47° to 20.47°<br>(See Note 3) | 0.01°                                |
|                                  | Back azimuth<br>antenna coor-<br>dinate system                     |                             | 1                    | (see Note 2)                      |                                      |
|                                  | Back azimuth<br>antenna height                                     |                             | 7                    | -63 m to +63 m<br>(see Note 3)    | 1 m                                  |
|                                  | Spare  |                             | 8                    |                                   |                                      |
|                                  | Parity   |                             | 7                    | (See Note 1)                      |                                      |

Table 8. Auxiliary Data (Cont'd)

| <u>Word<br/>(See<br/>Note 5)</u> | <u>Data Content</u>                     | <u>Type<br/>of<br/>Data</u> | <u>Bits<br/>Used</u> | <u>Range<br/>Of<br/>Values</u> | <u>Least<br/>Significant<br/>Bit</u> |
|----------------------------------|---|-----------------------------|----------------------|--------------------------------|--------------------------------------|
| A5                               | Preamble                                | dig-<br>ital                | 12                   |                                |                                      |
|                                  | Address                                 |                             | 8                    |                                |                                      |
|                                  | RVR (touchdown)                         |                             | 11                   | 0-2555m<br>(see Note 6)        | 5 m                                  |
|                                  | RVR (midpoint)                          |                             | 11                   | 0-2555m<br>(see Note 6)        | 5 m                                  |
|                                  | RVR (stopend)                           |                             | 11                   | 0-2555m<br>(see Note 6)        | 5 m                                  |
|                                  | Surface<br>Wind Speed                   |                             | 7                    | 0-127 knots                    | 1 knot                               |
|                                  | Surface Wind<br>Direction<br>(magnetic) |                             | 9                    | 0-359°                         | deg                                  |
|                                  | Parity                                  |                             | 7                    | see Note 1                     |                                      |

Table 8. Auxiliary Data (Cont'd)

NOTE 1: Parity bits I<sub>70</sub> to I<sub>76</sub> are chosen to satisfy the equations which follow.

For BIT I<sub>70</sub>

$$\text{EVEN} = (I_{13} + \dots + I_{18}) + I_{20} + I_{22} + I_{24} + I_{25} + I_{28} + I_{29} + I_{31} + I_{32} + I_{33} + I_{35} + I_{36} + I_{38} + I_{41} + I_{44} + I_{45} + I_{46} + I_{50} + (I_{52} + \dots + I_{55}) + I_{58} + I_{60} + I_{64} + I_{65} + I_{70}$$

For BIT I<sub>71</sub>

$$\text{EVEN} = (I_{14} + \dots + I_{19}) + I_{21} + I_{23} + I_{25} + I_{26} + I_{29} + I_{30} + I_{32} + I_{33} + I_{34} + I_{36} + I_{37} + I_{39} + I_{42} + I_{45} + I_{46} + I_{47} + I_{51} + (I_{53} + \dots + I_{56}) + I_{59} + I_{61} + I_{65} + I_{66} + I_{71}$$

For BIT I<sub>72</sub>

$$\text{EVEN} = (I_{15} + \dots + I_{20}) + I_{22} + I_{24} + I_{26} + I_{27} + I_{30} + I_{31} + I_{33} + I_{34} + I_{35} + I_{37} + I_{38} + I_{40} + I_{43} + I_{46} + I_{47} + I_{48} + I_{52} + (I_{54} + \dots + I_{57}) + I_{60} + I_{62} + I_{66} + I_{67} + I_{72}$$

For BIT I<sub>73</sub>

$$\text{EVEN} = (I_{16} + \dots + I_{21}) + I_{23} + I_{25} + I_{27} + I_{28} + I_{31} + I_{32} + I_{34} + I_{35} + I_{36} + I_{38} + I_{39} + I_{41} + I_{44} + I_{47} + I_{48} + I_{49} + I_{53} + (I_{55} + \dots + I_{58}) + I_{61} + I_{63} + I_{67} + I_{68} + I_{73}$$

For BIT I<sub>74</sub>

$$\text{EVEN} = (I_{17} + \dots + I_{22}) + I_{24} + I_{26} + I_{28} + I_{29} + I_{32} + I_{33} + I_{35} + I_{36} + I_{37} + I_{39} + I_{40} + I_{42} + I_{45} + I_{48} + I_{49} + I_{50} + I_{54} + (I_{56} + \dots + I_{59}) + I_{62} + I_{64} + I_{68} + I_{69} + I_{74}$$

For BIT I<sub>75</sub>

$$\text{EVEN} = (I_{13} + \dots + I_{17}) + I_{19} + I_{21} + I_{23} + I_{24} + I_{27} + I_{28} + I_{30} + I_{31} + I_{32} + I_{34} + I_{35} + I_{37} + I_{40} + I_{43} + I_{44} + I_{45} + I_{49} + (I_{51} + \dots + I_{54}) + I_{57} + I_{59} + I_{63} + I_{64} + I_{69} + I_{75}$$

For BIT I<sub>76</sub>

$$\text{EVEN} = I_{13} + I_{14} + \dots + I_{75} + I_{76}$$

NOTE 2: Code for I<sub>56</sub> is: 0 = conical  
1 = planar

Table 8. Auxiliary Data (Cont'd)

NOTE 3: The convention for the coding of negative numbers is as follows:

-MSB is the sign bit

0 = +

1 = -

- Other bits represent the absolute value.

The convention for the antenna location is as follows:

As viewed from the MLS approach reference datum looking toward the datum point, a positive number shall represent a location to the right of the runway centerline (lateral offset) or above the runway (vertical offset), or towards the stop end of the runway (longitudinal distance).

The convention for the antenna alignment is as follows:

As viewed from above, a positive number shall represent clockwise rotation from the runway centerline to the respective zero-degree guidance plane.

NOTE 4: The Auxiliary Data Words shall be transmitted throughout the appropriate guidance sectors at the minimum average rates (measured over a 10 second period) indicated below.

| Word | Transmission Rates (Hertz) |                     |                |
|------|----------------------------|---------------------|----------------|
|      | App. Az only               | If Back Az Provided |                |
|      | <u>App. Az</u>             | <u>App. Az</u>      | <u>Back Az</u> |
| 1    | 1.0                        | 1.0                 | N/A            |
| 2    | 1.0                        | 1.0                 | N/A            |
| 3    | 1.0                        | 0.75                | 0.25           |
| 4    | N/A                        | 0.25                | 0.75           |
| 5    | 1.0                        | 0.75                | 0.25           |

NOTE 5: The designation "A1" represents the function identification code for "Auxiliary Data A" and address code number 1.

NOTE 6: The tenth and eleventh bits transmitted for each RVR value are used to provide trend information. The convention for coding is as follow:

|            | Tenth bit | Eleventh bit |
|------------|-----------|--------------|
| Off        | 0         | 0            |
| Decreasing | 1         | 0            |
| Equal      | 0         | 1            |
| Increasing | 1         | 1            |

NOTE 7: Where appropriate data are available, auxiliary data word A5 shall be transmitted throughout the approach azimuth sector and back azimuth sector, if provided.

#### 4. GROUND EQUIPMENT REQUIREMENTS, ANGLE AND DATA FUNCTIONS

##### 4.1 Function transmissions

NOTE: Requirements for the DME/P are contained in FAA-E-2721/13.

4.1.1 Function timing.— Event time slots for each angle and data function shall be as specified in Tables: 14, 15, 16, 17, 18, and 19, Appendix II. The equipment internal timing accuracy of each listed event, including jitter, shall be the specified nominal value, plus or minus 2 microseconds. The timing jitter (i.e., the variations over a number of measurement sets) shall be less than 1 microsecond.

NOTE: The times listed indicate the beginning of the event time slot and the end of the previous event time slot. The characteristics of the actual transmissions are as specified in the applicable paragraphs.

4.1.2 Synchronization.— The transmission from the various angle and data ground equipment serving a particular runway shall be time synchronized to assure interference-free operations on the common radio frequency channel of operation.

4.1.3 Symmetrical scanning.— The TO and FRO scan transmissions shall be symmetrically disposed about the mid-scan point listed in each of Tables 14, 15, and 16. The mid-scan point and the center of the time interval between the TO and FRO scan shall coincide with a tolerance of plus or minus 10 microseconds.

##### 4.1.4 Radio frequency characteristics

4.1.4.1 Radio frequency signal spectrum.— The transmitted signal shall be such that, during the transmission time, the mean power density above a height of 600 meters (2,000 feet) shall not exceed  $-94.5 \text{ dBW/m}^2$  for angle guidance and data, as measured in a 150 kHz bandwidth centered 840 kHz or more from the nominal frequency.

4.1.4.2 Polarization.— The radio frequency transmissions from all ground equipment shall be nominally vertically polarized. The effect of any horizontally polarized component shall not cause the PFE limit to be exceeded at any location when the airborne antenna is rotated 30 degrees from the vertical position.

4.1.4.3 Frequency tolerance.— The operating radio frequency of the ground equipment shall not vary more than plus or minus 10 kHz from the assigned frequency. The frequency stability shall be such that there is no more than a plus or minus 50 Hz deviation from the nominal frequency when measured over a one-second interval.

4.1.4.4 Residual radiation.— The residual radiation of a transmitter associated with an MLS function during time intervals when it should not be transmitting shall not adversely affect the reception of any other function. The residual radiation of an MLS function at times when another function is radiating shall be at least 70 dB below the level provided when transmitting.

4.1.5 Modulation

4.1.5.1 Scanning beam transmissions.— Transmissions during the angle scan period shall be unmodulated continuous wave except that the rise/fall times at the beginning and end of scan shall be controlled as required by 4.1.4.1.

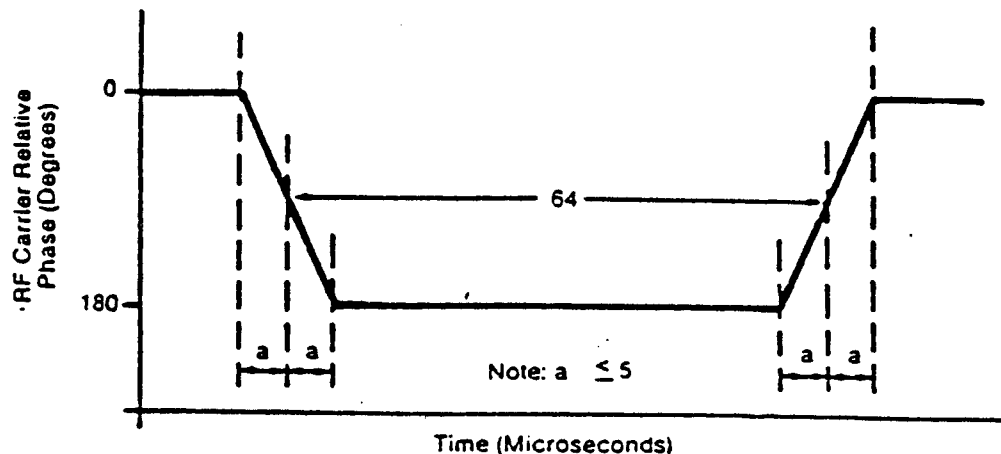
4.1.5.2 Data transmissions.— All codes and data shall be modulated by phase shift keying between the 0 degree and the 180 degree phase states of the radio frequency carrier with a tolerance of  $\pm 10$  degrees. The signalling rate shall be 15,625 bits per second. A phase transition shall be completed within 10 microseconds, and the phase shall advance (or retard) monotonically throughout the transition region. (see figure 12). Amplitude modulation during the phase transition period shall not be used.

4.1.5.3 Other transmissions.— Other transmissions required in the function formats shall be continuous wave pulses with durations and rise/fall times as specified.

4.1.6 False guidance.— False courses which can be acquired and tracked by an aircraft shall not exist anywhere either inside or outside of the MLS coverage sector within line of sight from the antenna phase center. False courses which would otherwise exist outside of the minimum coverage sector may be suppressed by the use of OCI.

NOTE: False courses may be due to (but not limited to) MLS airborne receiver acquisition of the following types of false guidance: reflections of the scanning beam, scanning beam antenna sidelobes, scanning beam antenna grating lobes, and incorrect clearance.

Figure 12. DPSK Phase Characteristics



#### 4.2 Coverage

**NOTE 1:** The ground equipment coverage requirements are specified based on an allowance for certain probabilistic propagation losses. These losses include rain, atmospheric effects, polarization, and horizontal and vertical multipath. The allowed probabilistic losses are 4.3 dB for data and pulsed clearance signals, 3.1 dB for azimuth guidance signals, and 2.5 dB for elevation guidance signals. The rain loss contribution is 2.2 dB. This will allow for the following rain conditions:

- 50 millimeters (2 inches) per hour through a distance of 5 nautical miles.
- 25 millimeters (1 inch) per hour through a distance of 15 nautical miles.

**NOTE 2:** Figures 13, 14, and 15 illustrate the coverage requirements for the Approach Azimuth/Data, Back Azimuth/Data Coverage, and Approach Elevation functions respectively. The coverages shown are defined to include both proportional and clearance guidance. The maximum proportional scan limits are shown in Table 2.

**NOTE 3:** Where intervening obstacles penetrate the 0.9 degree lower coverage surface, it is not intended that guidance be provided at less than line of sight heights. Line of sight (LOS) here means the electrical line of sight which is defined as follows:

$LOS\ (deg) = Optical\ LOS\ (deg) + 57.3 * SQRT\ (0.2/R)$   
Where R = distance from antenna to intervening obstacle (feet)

4.2.1 (Not used)

4.2.2 Approach Azimuth/Data.— The Approach Azimuth/Data ground equipment shall provide guidance information in at least the following volumes of space as illustrated in Figure 13.

4.2.2.1 Approach region

- (a) Horizontally within a sector plus or minus 40 degrees about the runway center line originating at the MLS datum point and extending in the direction of the approach to 20 nautical miles. For those systems providing Azimuth guidance to  $\pm 60$ -degrees, coverage shall extend to at least 14 nautical miles beyond  $\pm 40$ -degrees.
- (b) Vertically between conical surfaces which originate on a vertical line passing through the MLS datum point, of which:
  - (1) The lower surface crosses threshold at 2.5 meters (8 ft) above the runway centerline inclined at 0.9 degree above the horizontal;
  - (2) The upper surface crosses threshold at 600 meters (2,000 ft) above centerline inclined at 15 degrees above the horizontal to a height of 6,000 meters (20,000 ft).



Figure 13. Approach Azimuth/Data Coverage

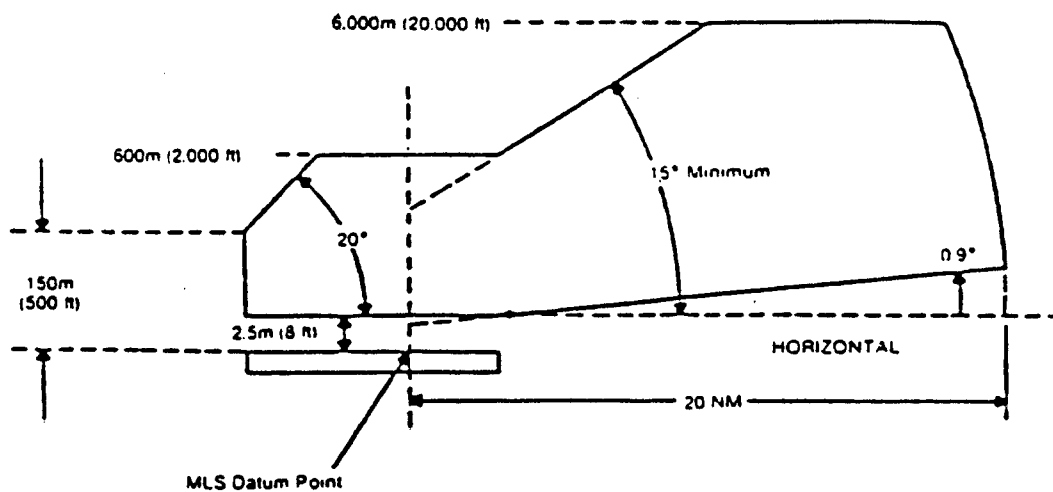
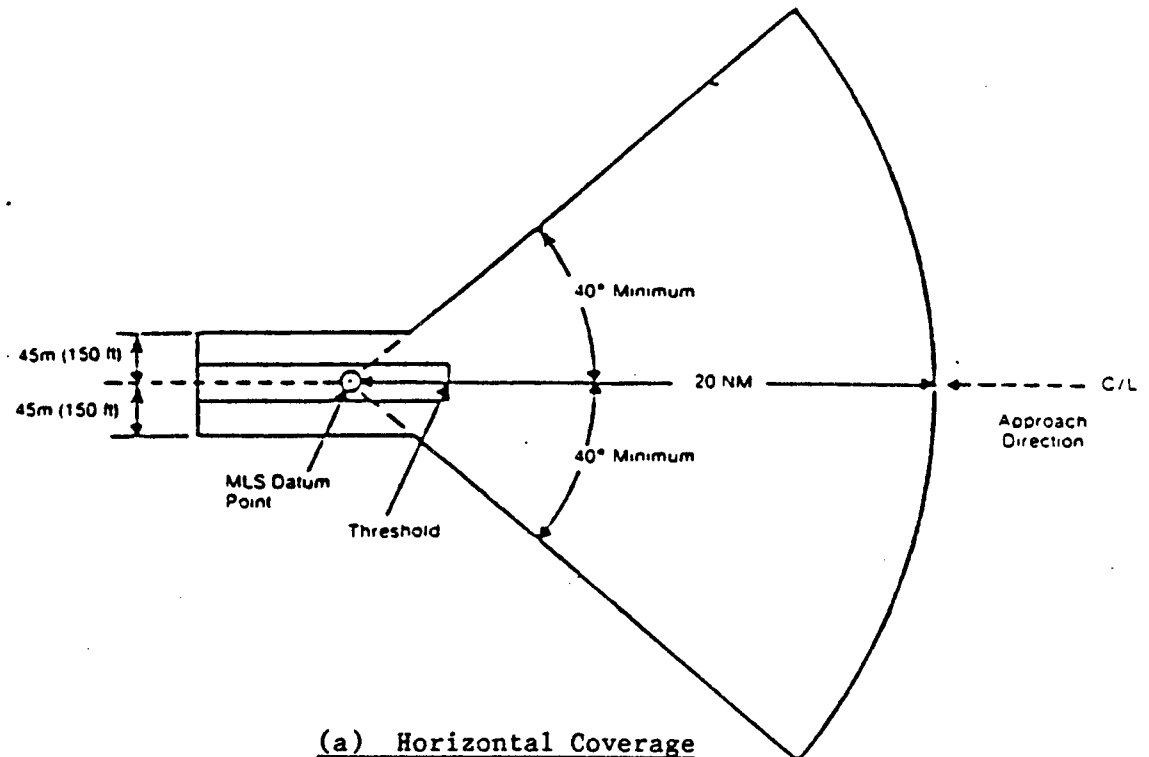


Figure 14. Back Azimuth/Data Coverage

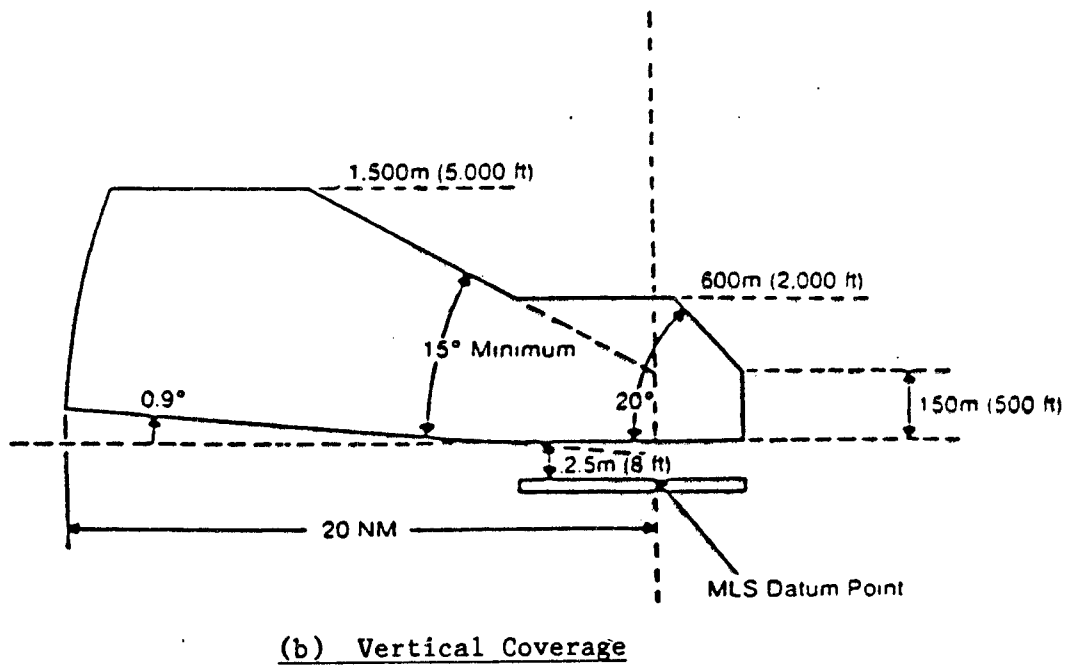
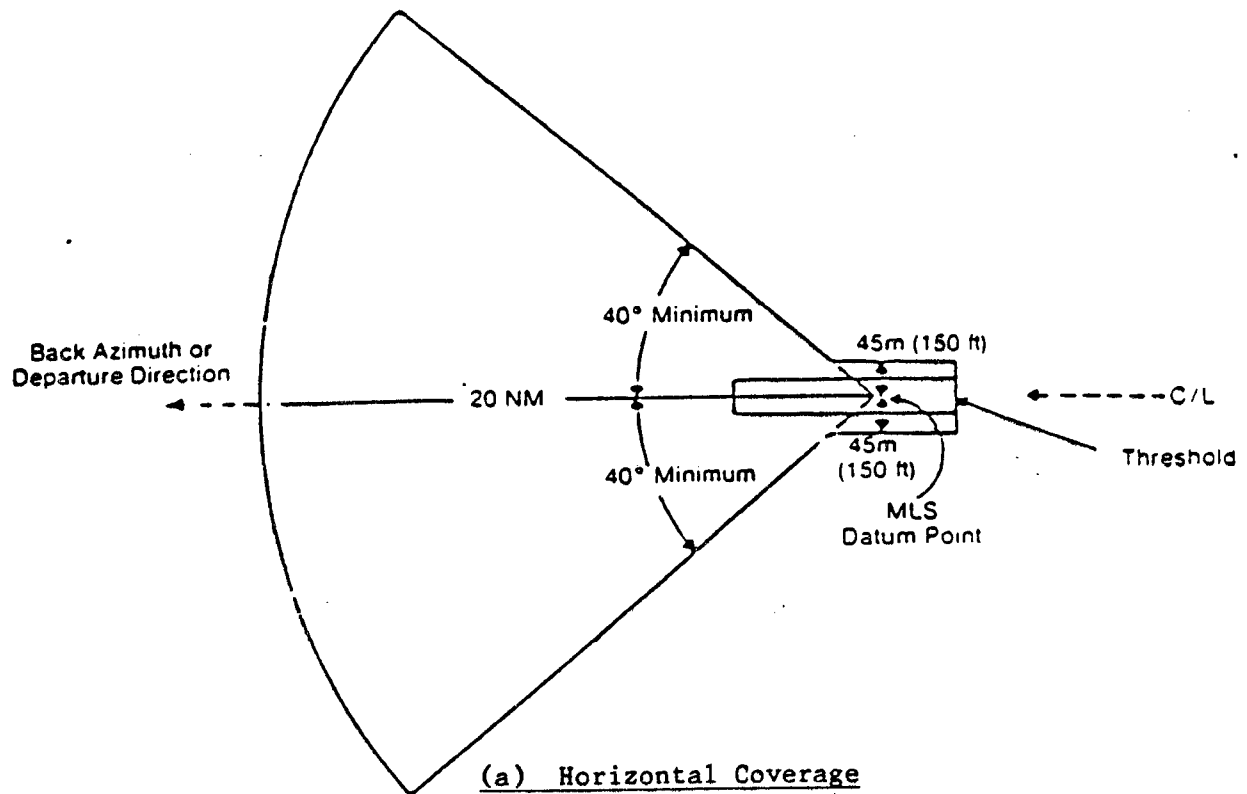
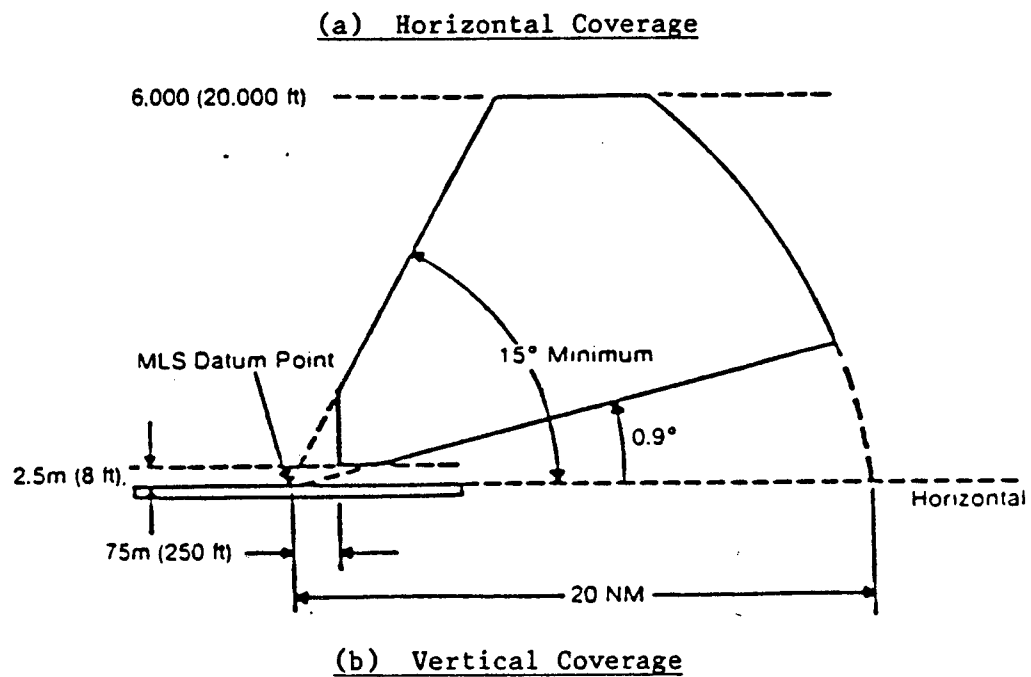
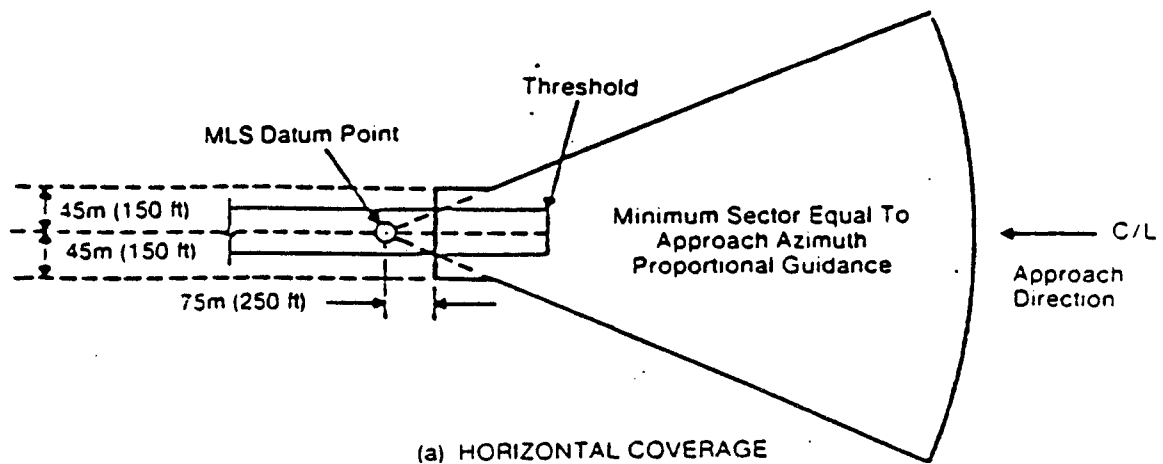


Figure 15. Approach Elevation Coverage

4.2.2.2 Runway region (Approach)

- (a) Horizontally within a sector 45 meters (150 ft) each side of the runway centerline beginning at the stop end and extending parallel with the runway centerline in the direction of the approach to join the approach region.
- (b) Vertically between:
  - (1) A horizontal surface which is 2.5 meters (8 ft) above the runway centerline; and
  - (2) A conical surface originating along the centerline extended beyond the stop end of the runway which crosses the stop end at 150 meters (500 ft) above centerline inclined at 20 degrees above the horizontal up to a height of 600 meters (2,000 ft).

4.2.2.2.1 Minimum proportional guidance.— Proportional guidance shall be provided throughout the runway region and in a sector of at least plus or minus 10 degrees about the runway centerline extended in the approach region.

4.2.3 Back Azimuth/Data

4.2.3.1 Back Azimuth region.— The Back Azimuth/Data ground equipment shall provide information in at least the following volume of space as illustrated in Figure 14.

- (a) Horizontally in the Back Azimuth region within a sector plus or minus 40 degrees about the runway centerline originating at the MLS datum point and extending in the direction of the missed approach at least to 20 nautical miles.
- (b) Vertically in the Back Azimuth region between conical surfaces which originate on a vertical line passing through the MLS datum point, of which:
  - (1) The lower surface crosses the stop end at 2.5 meters (8 ft) above the runway centerline inclined at 0.9 degrees above the horizontal;
  - (2) The upper surface crosses the stop end at 600 meters (2,000 ft) above centerline inclined at 15 degrees above the horizontal to a height of 6,000 meters (20,000 ft).

4.2.3.2 Runway region (Back Azimuth)

- (a) Horizontally within a sector 45 meters (150 ft) each side of the runway centerline beginning at the threshold and extending parallel with the runway centerline in the direction of the stop end to join the Back Azimuth region.

## (b) Vertically between:

- (1) A horizontal surface which is 2.5 meters (8 ft) above the runway centerline; and
- (2) A conical surface originating along the centerline extended beyond the threshold of the runway which crosses the threshold at 150 meters (500 ft) above centerline inclined at 20 degrees above the horizontal up to a height of 600 meters (2,000 ft).

4.2.3.3 Minimum proportional guidance.— Proportional guidance shall be provided throughout the runway region and in a sector of at least plus or minus 10 degrees about the runway centerline extended in the Back Azimuth region.

#### 4.2.4 Approach Elevation

4.2.4.1 Coverage limits.— The Approach Elevation ground equipment shall provide proportional guidance information in at least the following volume of space as illustrated in Figure 15.

- (a) Laterally throughout the approach and runway regions within which proportional guidance is provided by the Approach Azimuth ground equipment.
- (b) Longitudinally from 75 meters (250 ft) from the MLS datum point in the direction of the approach to 20 nautical miles.
- (c) Vertically within the sector bounded by:
  - (1) A surface which is the locus of points 2.5 meters (8 ft) above the runway;
  - (2) A conical surface originating at the MLS datum point and inclined 0.9 degree above the horizontal; and
  - (3) A conical surface originating at the MLS datum point and inclined 15 degrees above the horizontal up to a height of 6,000 meters (20,000 ft).

#### 4.2.5 Data Coverage

##### 4.2.5.1 Basic data

4.2.5.1.1 Approach azimuth: Basic Data Words 1, 2, 3, 4, and 6 shall be transmitted throughout the Approach Azimuth coverage sector.

4.2.5.1.2 Back azimuth: When the Back Azimuth function is provided, Basic Data Words 4, 5, and 6 shall be transmitted throughout the Approach Azimuth and Back Azimuth coverage sectors.

4.2.5.2 Auxiliary data

4.2.5.2.1 Approach azimuth: Auxiliary Data Words A1, A2, and A3 shall be transmitted throughout the Approach Azimuth coverage sector.

4.2.5.2.2 Back azimuth: When the Back Azimuth function is provided, Auxiliary Data Words A3 and A4 shall be transmitted throughout the Approach Azimuth and Back Azimuth coverage sectors.

NOTE: The composition of the data words is given in 3.6 and 3.7.

4.2.6 Precision Distance Measuring Equipment (DME/P).— DME/P information shall be provided at least throughout the coverage volume in which Approach and Back Azimuth guidance is available.

4.3 (Not used).—

4.4 (Not used).—

4.5 Scanning beam antenna patterns.— Azimuth ground equipment antennas shall produce a fan-shaped beam which is narrow in the horizontal plane and broad in the vertical plane. Elevation ground equipment antennas shall produce a fan-shaped beam which is narrow in the vertical plane and broad in the horizontal plane.

4.5.1 Coordinate systems.— Azimuth guidance information shall be radiated in either conical or planar coordinates as illustrated in Figure 21. Approach elevation guidance information shall be radiated in conical coordinates as illustrated in Figure 22. The coordinate system used for Azimuth guidance shall be identified in auxiliary data word A1.

4.5.2 Antenna patterns in the scan plane

4.5.2.1 Beamwidth.— The antenna beamwidth shall not exceed 4 degrees at boresight.

NOTE: It is intended that the detected scanning beam envelope throughout the coverage not exceed 250 microseconds in order to insure proper angle decoding by the airborne equipment.

4.5.2.2 Beam shape.— The Azimuth scanning beam envelope on the antenna bore-sight and the elevation scanning beam envelope at the minimum glide path angle, as detected by a standard receiver, shall conform to the limits specified in Figure 18 under conditions of high SNR and negligible multipath, (e.g., during a trial on an antenna range). The -10 dB points on the beam envelope shall be displaced from the beam center by at least 0.76 beamwidth, but not more than 0.96 beamwidth.

4.5.2.3 Sidelobes

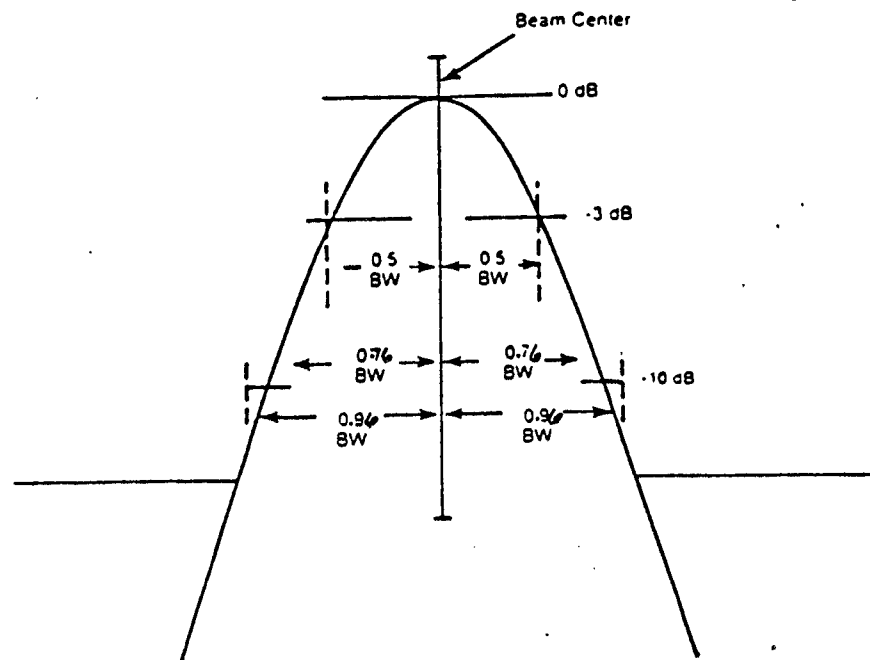
NOTE: The antenna pattern characteristics may also depend upon equipment or propagation error budgets contained in equipment specifications.

4.5.2.3.1 Dynamic sidelobes.- At any point in space around the antenna, the level of the dynamic sidelobes or any other signal generated by the scanning beam antenna shall be at least 10 dB below the minimum level of the main lobe within the guidance sector.

4.5.2.3.2 Effective sidelobe levels.- The scanning beam antenna sidelobes in the plane of scan shall not cause control motion noise in excess of that allocated to the propagation budget for azimuth functions or path following error and control motion noise in excess of that allocated in the propagation budget for elevation functions.

4.5.2.3.3 Rising terrain.- In order to accommodate rising terrain in the approach region, elevation antennas shall be able to achieve the performance requirements of paragraph 3.5 when a mainlobe reflection attenuated by 15 dB exists at a separation angle of 1.2 beamwidths or greater with worst-case relative phase.

Figure 18. Far Field Dynamic Signal-In-Space



#### 4.5.3 Antenna patterns in the plane orthogonal to scan

4.5.3.1 Azimuth.— The azimuth antenna pattern above the horizontal shall be consistent with the coverage and RF signal spectrum requirements (4.1.4.1). Below the horizontal, the pattern shall be shaped to limit PFE due to the ground reflection and to limit the variations caused by changing terrain conditions in the ground reflection regions.



4.5.3.2 Elevation.— The horizontal pattern of the elevation antenna shall be shaped to limit multipath errors in the installed environment consistent with the propagation error allowance for CMN.

NOTE: Typically, the horizontal pattern of the Approach Elevation antenna is reduced by 3 dB at 20 degrees off the boresight and by more than 6 dB at angles greater than 40 degrees.

#### 4.6 Monitor and control

4.6.1 Synchronization and monitoring.— The synchronization of the time-division-multiplexed angle guidance and data transmissions which are listed in Table 3 shall be monitored.

4.6.2 Azimuth.— The Approach Azimuth and Back Azimuth monitor systems shall cause the radiation of their respective functions to cease and a warning shall be provided at the designated control points if any of the following conditions persist for longer than the periods specified:

- (a) There is a change in the ground equipment contribution to the mean course error component such that the PFE at the approach reference datum or in the direction of any Azimuth radial, exceeds the limits specified in Table 5 for a period not to exceed one second.
- (b) There is a reduction in the radiated power to less than that necessary to satisfy the requirements specified in Table 10 for a period not to exceed one second.
- (c) There is an error in the preamble DPSK transmissions which occurs more than once in any one second period.
- (d) There is an error in the TDM synchronization of a particular Azimuth function such that interference-free transmissions between functions are not maintained, and this condition persists for more than one second.
- (e) Erroneous signals are transmitted during the interval between function transmissions for a period not to exceed one second.

4.6.2.1 Monitor failure.— Design and operation of the monitor system shall cause radiation to cease and a warning shall be provided at the designated control points in the event of failure of the monitor system itself.

4.6.2.2 Erroneous guidance control.— The period during which erroneous guidance information is radiated, including period(s) of zero radiation and fault detection (4.6.2) shall not exceed one second. Attempts to clear a fault by resetting the primary ground equipment or by switching to standby ground equipment shall be completed within this time. If the fault is not

cleared within the time allowed, the radiation shall cease. After shutdown, no attempt shall be made to restore service until a period of 20 seconds has elapsed.

4.6.3 Elevation.— The Approach Elevation monitor system shall cause the radiation to cease and warning shall be provided at the designated control point if any of the following conditions persist for longer than the periods specified:

- (a) There is a change in the ground equipment contribution to the mean glide path error component such that the PFE at the approach reference datum or on any glide path consistent with published approach procedures exceeds the limits specified in Table 5 for a period not to exceed one second.
- (b) There is a reduction in the radiated power to less than that necessary to satisfy the requirements specified in Table 4 for a period not to exceed one second.
- (c) There is an error in the preamble DPSK transmissions which occurs more than once in any one-second period.
- (d) There is an error in the TDM synchronization of a particular elevation function such that the interference-free transmissions between functions are not maintained and this condition persists for more than one second.
- (e) Erroneous signals are transmitted during the interval between function transmissions for a period not to exceed one second.

4.6.3.1 Monitor failure.— Design and operation of the monitor system shall cause radiation to cease and a warning shall be provided at the designated control points in the event of failure of the monitor system itself.

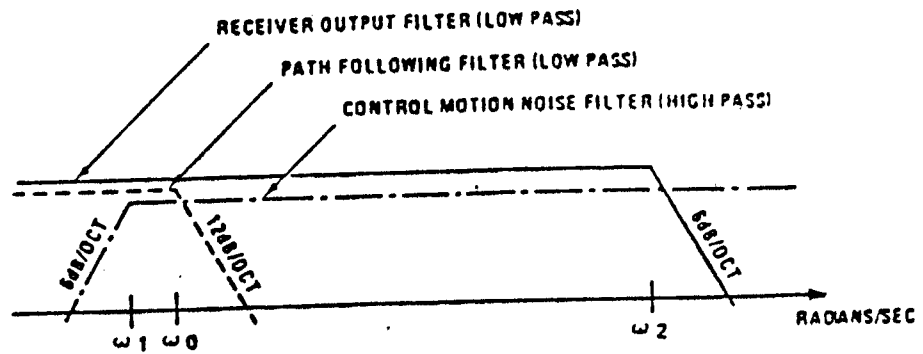
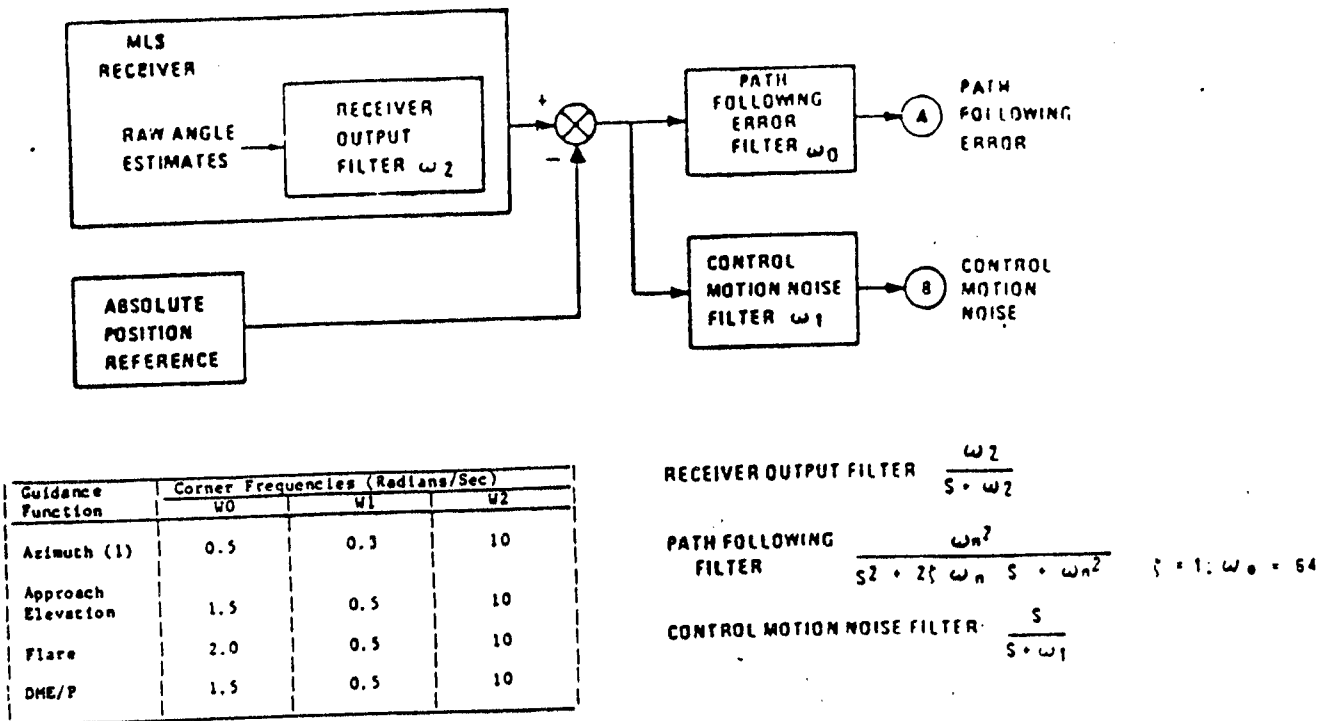
4.6.3.2 Erroneous guidance control.— The period during which erroneous guidance information is radiated, including period(s) of zero radiation and fault detection (4.6.3) shall not exceed one second. Attempts to clear a fault by resetting the primary ground equipment or by switching to standby ground equipment shall be completed within this time. If the fault is not cleared within the time allowed, radiation shall cease. After shutdown no attempt shall be made to restore service until a period of 20 seconds has elapsed.

4.6.4 Data transmissions.— The monitor system shall cause radiation of a data word to cease and warning shall be provided at the designated control point if any of the following conditions persist for longer than the periods specified:

- a. There is a reduction in the radiated power to less than that necessary to satisfy the requirements in Table 4, for a period of not to exceed one second.
- b. There is an error in a data word in two consecutive samples.
- c. There is an error in the TDM synchronization of any data words such that interference-free transmissions between functions are not maintained and this condition persists for more than one second.

4.6.4.1 Monitor failure.— Design and operation of the monitor system shall cause radiation to cease and a warning shall be provided at the designated control points in the event of failure of the monitor system itself.

Figure 19. Filter Configurations and Corner Frequencies



NOTE (1): Applies to Approach Azimuth, High Rate Approach Azimuth, and Back Azimuth.

## 5. AIRBORNE EQUIPMENT CHARACTERISTICS

NOTE 1: Requirements for the DME/P airborne equipment are contained in Minimum Operational Performance Standards for Airborne Distance Measuring Equipment (DME) Operating Within the Frequency Range of 960-1215 MHz, Doc. No. DO-189.

NOTE 2: Requirements for the angle airborne equipment are contained in Minimum Operational Performance Standards for Microwave Landing System (MLS) Airborne Receiver Equipment, RTCA, Doc. No. DO-177.

## 6. MLS MEASUREMENT METHODOLOGY

6.1 PFE and CMN frequency components.— The PFE shall be comprised of those frequency components of the guidance signal error at the output of the airborne receiver which lie below 0.5 radian per second for Azimuth guidance information or below 1.5 radians per second for elevation guidance information. The control motion noise shall be comprised of those frequency components of the guidance signal error at the output of the airborne receiver which lie above 0.3 radian per second for Azimuth guidance or above 0.5 radian per second for elevation guidance information. The output filter corner frequency of the receiver used for this measurement is 10 radians per second.

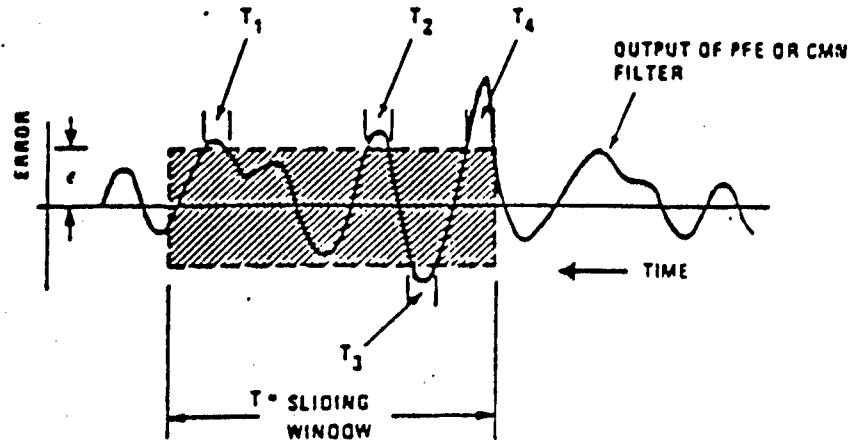
6.2 Error evaluation.— The PFE estimates shall be obtained at the output of the PFE filter (test point A in Figure 19). The CMN estimates shall be obtained at the output of the CMN filter (test point B in Figure 19). Filter corner frequencies shall be as shown in Figure 19.

6.2.1 Azimuth and elevation functions.— The PFE and CMN for Approach Azimuth or for Back Azimuth shall be evaluated over any 40-second interval of the flight error record taken within the coverage limits (i.e.,  $T=40$  in Figure 20). The PFE and CMN for Approach Elevation shall be evaluated over any 10-second interval of the flight error record taken within the coverage limits (i.e.,  $T=10$  in Figure 20.)

NOTE 1: The 95 percent probability requirement is interpreted to be met if the PFE or CMN does not exceed the specified error limits for more than 5 percent of the evaluation interval (see Figure 20).

NOTE 2: The PFN is derived by setting the mean error of the PFE over any evaluation interval to zero.

Figure 20. MLS Measurement Methodology



NOTES:

$\epsilon$  = ERROR SPECIFICATION

T = REGION TO BE EVALUATED

$T_1 T_2 T_3 \dots$  = TIME INTERVALS THAT ERROR EXCEEDS SPECIFICATIONS. FOR THE GROUND EQUIPMENT TO BE ACCEPTABLE IN THIS REGION, THE FOLLOWING INEQUALITY SHOULD BE TRUE.

$$\frac{(T_1 + T_2 + T_3 + \dots)}{T} \leq 0.05$$

Figure 21. Coordinate System for Azimuth Functions

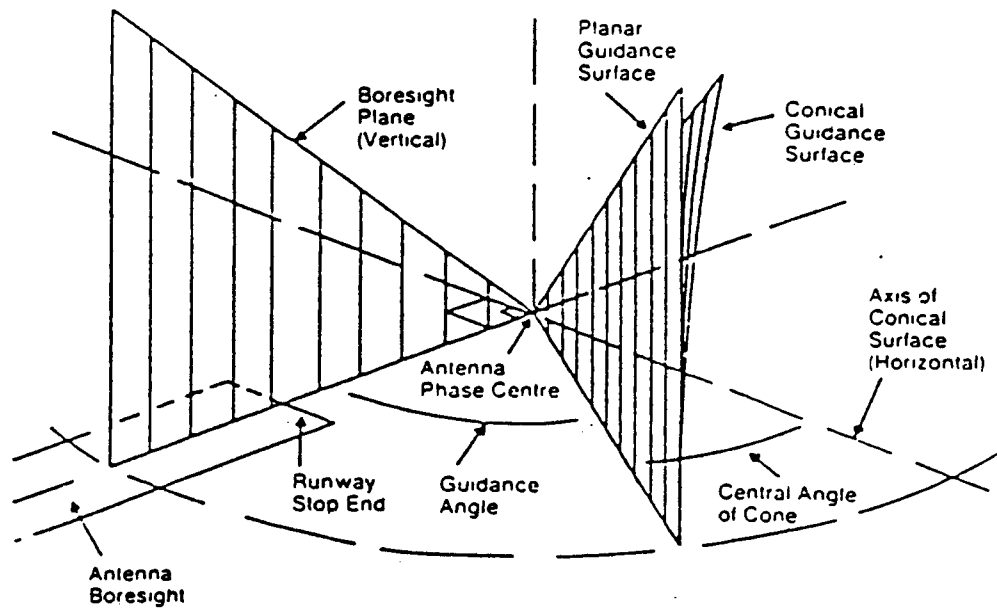
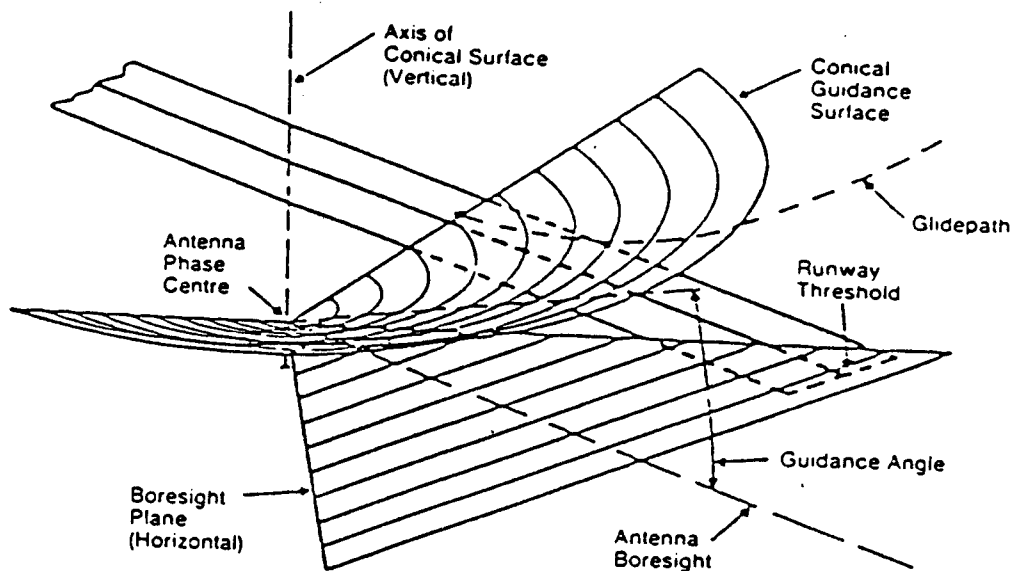


Figure 22. Conical Coordinate Systems for Elevation Functions



APPENDIX I

10. MLS ANGLE, DATA AND DME/P CHANNELING

10.1 Angle and Data channels.- The channeling of MLS Angle and Data functions shall be as shown in Table 12.

10.2 Precision Distance Measuring Equipment (DME/P) channels.- The channeling of DME/P equipment and the pairing with angle channels shall be as shown in Table 12.



Table 12. MLS Channel Pairing

| Channel Pairing |            |        |     | DME Parameters |               |                     |            |           |             |
|-----------------|------------|--------|-----|----------------|---------------|---------------------|------------|-----------|-------------|
|                 |            |        |     | Interrogation  |               |                     |            | Reply     |             |
|                 |            |        |     | DME No         | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH No  | Freq. MHz | Pulse Codes |
| DME/N $\mu$ s   | DME/P Mode |        |     |                |               |                     |            |           |             |
|                 |            |        |     |                |               | IA $\mu$ s          | FA $\mu$ s |           |             |
| * 1X            | -          | -      | -   | 1025           | 12            | -                   | -          | 962       | 12          |
| ** 1Y           | -          | -      | -   | 1025           | 36            | -                   | -          | 1088      | 30          |
| * 2X            | -          | -      | -   | 1026           | 12            | -                   | -          | 963       | 12          |
| ** 2Y           | -          | -      | -   | 1026           | 36            | -                   | -          | 1089      | 30          |
| * 3X            | -          | -      | -   | 1027           | 12            | -                   | -          | 964       | 12          |
| ** 3Y           | -          | -      | -   | 1027           | 36            | -                   | -          | 1090      | 30          |
| * 4X            | -          | -      | -   | 1028           | 12            | -                   | -          | 965       | 12          |
| ** 4Y           | -          | -      | -   | 1028           | 36            | -                   | -          | 1091      | 30          |
| * 5X            | -          | -      | -   | 1029           | 12            | -                   | -          | 966       | 12          |
| ** 5Y           | -          | -      | -   | 1029           | 36            | -                   | -          | 1092      | 30          |
| * 6X            | -          | -      | -   | 1030           | 12            | -                   | -          | 967       | 12          |
| ** 6Y           | -          | -      | -   | 1030           | 36            | -                   | -          | 1093      | 30          |
| * 7X            | -          | -      | -   | 1031           | 12            | -                   | -          | 968       | 12          |
| ** 7Y           | -          | -      | -   | 1031           | 36            | -                   | -          | 1094      | 30          |
| * 8X            | -          | -      | -   | 1032           | 12            | -                   | -          | 969       | 12          |
| ** 8Y           | -          | -      | -   | 1032           | 36            | -                   | -          | 1095      | 30          |
| * 9X            | -          | -      | -   | 1033           | 12            | -                   | -          | 970       | 12          |
| ** 9Y           | -          | -      | -   | 1033           | 36            | -                   | -          | 1096      | 30          |
| * 10X           | -          | -      | -   | 1034           | 12            | -                   | -          | 971       | 12          |
| ** 10Y          | -          | -      | -   | 1034           | 36            | -                   | -          | 1097      | 30          |
| * 11X           | -          | -      | -   | 1035           | 12            | -                   | -          | 972       | 12          |
| ** 11Y          | -          | -      | -   | 1035           | 36            | -                   | -          | 1098      | 30          |
| * 12X           | -          | -      | -   | 1036           | 12            | -                   | -          | 973       | 12          |
| ** 12Y          | -          | -      | -   | 1036           | 36            | -                   | -          | 1099      | 30          |
| * 13X           | -          | -      | -   | 1037           | 12            | -                   | -          | 974       | 12          |
| ** 13Y          | -          | -      | -   | 1037           | 36            | -                   | -          | 1100      | 30          |
| * 14X           | -          | -      | -   | 1038           | 12            | -                   | -          | 975       | 12          |
| ** 14Y          | -          | -      | -   | 1038           | 36            | -                   | -          | 1101      | 30          |
| * 15X           | -          | -      | -   | 1039           | 12            | -                   | -          | 976       | 12          |
| ** 15Y          | -          | -      | -   | 1039           | 36            | -                   | -          | 1102      | 30          |
| * 16X           | -          | -      | -   | 1040           | 12            | -                   | -          | 977       | 12          |
| ** 16Y          | -          | -      | -   | 1040           | 36            | -                   | -          | 1103      | 30          |
| ▽ 17X           | 108.00     | -      | -   | 1041           | 12            | -                   | -          | 978       | 12          |
| 17Y             | 108.05     | 5043.0 | 540 | 1041           | 36            | 36                  | 42         | 1104      | 30          |
| 17Z             | -          | 5043.3 | 541 | 1041           | -             | 21                  | 27         | 1104      | 15          |
| 18X             | 108.10     | 5031.0 | 500 | 1042           | 12            | 12                  | 18         | 979       | 12          |
| 18W             | -          | 5031.3 | 501 | 1042           | -             | 24                  | 30         | 979       | 24          |
| 18Y             | 108.15     | 5043.6 | 542 | 1042           | 36            | 36                  | 42         | 1105      | 30          |
| 18Z             | -          | 5043.9 | 543 | 1042           | -             | 21                  | 27         | 1105      | 15          |
| 19X             | 108.20     | -      | -   | 1043           | 12            | -                   | -          | 980       | 12          |
| 19Y             | 108.25     | 5044.2 | 544 | 1043           | 36            | 36                  | 42         | 1106      | 30          |
| 19Z             | -          | 5044.5 | 545 | 1043           | -             | 21                  | 27         | 1106      | 15          |
| 20X             | 108.30     | 5031.6 | 502 | 1044           | 12            | 12                  | 18         | 981       | 12          |
| 20W             | -          | 5031.9 | 503 | 1044           | -             | 24                  | 30         | 981       | 24          |
| 20Y             | 108.35     | 5044.8 | 546 | 1044           | 36            | 36                  | 42         | 1107      | 30          |
| 20Z             | -          | 5045.1 | 547 | 1044           | -             | 21                  | 27         | 1107      | 15          |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |            | DME Parameters |               |            |            |           |                     |
|-----------------|---------------|---------------------|------------|----------------|---------------|------------|------------|-----------|---------------------|
|                 |               |                     |            | Interrogation  |               |            |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH. No | Freq. MHz      | Pulse Codes   |            |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |            |                | DME/N $\mu$ s | DME/P Mode |            |           |                     |
|                 |               |                     |            |                |               | IA $\mu$ s | FA $\mu$ s |           |                     |
| 21X             | 108.40        | -                   | -          | 1045           | 12            | -          | -          | 982       | 12                  |
| 21Y             | 108.45        | 5045.4              | 548        | 1045           | 36            | 36         | 42         | 1108      | 30                  |
| 21Z             | -             | 5045.7              | 549        | 1045           | -             | 21         | 27         | 1108      | 15                  |
| 22X             | 108.50        | 5032.2              | 504        | 1046           | 12            | 12         | 18         | 983       | 12                  |
| 22W             | -             | 5032.5              | 505        | 1046           | -             | 24         | 30         | 983       | 24                  |
| 22Y             | 108.55        | 5046.0              | 550        | 1046           | 36            | 36         | 42         | 1109      | 30                  |
| 22Z             | -             | 5046.3              | 551        | 1046           | -             | 21         | 27         | 1109      | 15                  |
| 23X             | 108.60        | -                   | -          | 1047           | 12            | -          | -          | 984       | 12                  |
| 23Y             | 108.65        | 5046.6              | 552        | 1047           | 36            | 36         | 42         | 1110      | 30                  |
| 23Z             | -             | 5046.9              | 553        | 1047           | -             | 21         | 27         | 1110      | 15                  |
| 24X             | 108.70        | 5032.8              | 506        | 1048           | 12            | 12         | 18         | 985       | 12                  |
| 24W             | -             | 5033.1              | 507        | 1048           | -             | 24         | 30         | 985       | 24                  |
| 24Y             | 108.75        | 5047.2              | 554        | 1048           | 36            | 36         | 42         | 1111      | 30                  |
| 24Z             | -             | 5047.5              | 555        | 1048           | -             | 21         | 27         | 1111      | 15                  |
| 25X             | 108.80        | -                   | -          | 1049           | 12            | -          | -          | 986       | 12                  |
| 25Y             | 108.85        | 5047.8              | 556        | 1049           | 36            | 36         | 42         | 1112      | 30                  |
| 25Z             | -             | 5048.1              | 557        | 1049           | -             | 21         | 27         | 1112      | 15                  |
| 26X             | 108.90        | 5033.4              | 508        | 1050           | 12            | 12         | 18         | 987       | 12                  |
| 26W             | -             | 5033.7              | 509        | 1050           | -             | 24         | 30         | 987       | 24                  |
| 26Y             | 108.95        | 5048.4              | 558        | 1050           | 36            | 36         | 42         | 1113      | 30                  |
| 26Z             | -             | 5048.7              | 559        | 1050           | -             | 21         | 27         | 1113      | 15                  |
| 27X             | 109.00        | -                   | -          | 1051           | 12            | -          | -          | 988       | 12                  |
| 27Y             | 109.05        | 5049.0              | 560        | 1051           | 36            | 36         | 42         | 1114      | 30                  |
| 27Z             | -             | 5049.3              | 561        | 1051           | -             | 21         | 27         | 1114      | 15                  |
| 28X             | 109.10        | 5034.0              | 510        | 1052           | 12            | 12         | 18         | 989       | 12                  |
| 28W             | -             | 5034.3              | 511        | 1052           | -             | 24         | 30         | 989       | 24                  |
| 28Y             | 109.15        | 5049.6              | 562        | 1052           | 36            | 36         | 42         | 1115      | 30                  |
| 28Z             | -             | 5049.9              | 563        | 1052           | -             | 21         | 27         | 1115      | 15                  |
| 29X             | 109.20        | -                   | -          | 1053           | 12            | -          | -          | 990       | 12                  |
| 29Y             | 109.25        | 5050.2              | 564        | 1053           | 36            | 36         | 42         | 1116      | 30                  |
| 29Z             | -             | 5050.5              | 565        | 1053           | -             | 21         | 27         | 1116      | 15                  |
| 30X             | 109.30        | 5034.6              | 512        | 1054           | 12            | 12         | 18         | 991       | 12                  |
| 30W             | -             | 5034.9              | 513        | 1054           | -             | 24         | 30         | 991       | 24                  |
| 30Y             | 109.35        | 5050.8              | 566        | 1054           | 36            | 36         | 42         | 1117      | 30                  |
| 30Z             | -             | 5051.1              | 567        | 1054           | -             | 21         | 27         | 1117      | 15                  |
| 31X             | 109.40        | -                   | -          | 1055           | 12            | -          | -          | 992       | 12                  |
| 31Y             | 109.45        | 5051.4              | 568        | 1055           | 36            | 36         | 42         | 1118      | 30                  |
| 31Z             | -             | 5051.7              | 569        | 1055           | -             | 21         | 27         | 1118      | 15                  |
| 32X             | 109.50        | 5035.2              | 514        | 1056           | 12            | 12         | 18         | 993       | 12                  |
| 32W             | -             | 5035.5              | 515        | 1056           | -             | 24         | 30         | 993       | 24                  |
| 32Y             | 109.55        | 5052.0              | 570        | 1056           | 36            | 36         | 42         | 1119      | 30                  |
| 32Z             | -             | 5052.3              | 571        | 1056           | -             | 21         | 27         | 1119      | 15                  |
| 33X             | 109.60        | -                   | -          | 1057           | 12            | -          | -          | 994       | 12                  |
| 33Y             | 109.65        | 5052.6              | 572        | 1057           | 36            | 36         | 42         | 1120      | 30                  |
| 33Z             | -             | 5052.9              | 573        | 1057           | -             | 21         | 27         | 1120      | 15                  |
| 34X             | 109.70        | 5035.8              | 516        | 1058           | 12            | 12         | 18         | 995       | 12                  |
| 34W             | -             | 5036.1              | 517        | 1058           | -             | 24         | 30         | 995       | 24                  |
| 34Y             | 109.75        | 5053.2              | 574        | 1058           | 36            | 36         | 42         | 1121      | 30                  |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |           | DME Parameters |               |            |            |           |                     |
|-----------------|---------------|---------------------|-----------|----------------|---------------|------------|------------|-----------|---------------------|
|                 |               |                     |           | Interrogation  |               |            |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH No | Freq. MHz      | Pulse Codes   |            |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |           |                | DME/N $\mu$ s | DME/P Mode |            |           |                     |
|                 |               |                     |           |                |               | IA $\mu$ s | FA $\mu$ s |           |                     |
| 34Z             | -             | 5053.5              | 575       | 1058           | -             | 21         | 27         | 1121      | 15                  |
| 35X             | 109.80        | -                   | -         | 1059           | 12            | -          | -          | 996       | 12                  |
| 35Y             | 109.85        | 5053.8              | 576       | 1059           | 36            | 36         | 42         | 1122      | 30                  |
| 35Z             | -             | 5054.1              | 577       | 1059           | -             | 21         | 27         | 1122      | 15                  |
| 36X             | 109.90        | 5036.4              | 518       | 1060           | 12            | 12         | 18         | 997       | 12                  |
| 36W             | -             | 5036.7              | 519       | 1060           | -             | 24         | 30         | 997       | 24                  |
| 36Y             | 109.95        | 5054.4              | 578       | 1060           | 36            | 36         | 42         | 1123      | 30                  |
| 36Z             | -             | 5054.7              | 579       | 1060           | -             | 21         | 27         | 1123      | 15                  |
| 37X             | 110.00        | -                   | -         | 1061           | 12            | -          | -          | 998       | 12                  |
| 37Y             | 110.05        | 5055.0              | 580       | 1061           | 36            | 36         | 42         | 1124      | 30                  |
| 37Z             | -             | 5055.3              | 581       | 1061           | -             | 21         | 27         | 1124      | 15                  |
| 38X             | 110.10        | 5037.0              | 520       | 1062           | 12            | 12         | 18         | 999       | 12                  |
| 38W             | -             | 5037.3              | 521       | 1062           | -             | 24         | 30         | 999       | 24                  |
| 38Y             | 110.15        | 5055.6              | 582       | 1062           | 36            | 36         | 42         | 1125      | 30                  |
| 38Z             | -             | 5055.9              | 583       | 1062           | -             | 21         | 27         | 1125      | 15                  |
| 39X             | 110.20        | -                   | -         | 1063           | 12            | -          | -          | 1000      | 12                  |
| 39Y             | 110.25        | 5056.2              | 584       | 1063           | 36            | 36         | 42         | 1126      | 30                  |
| 39Z             | -             | 5056.5              | 585       | 1063           | -             | 21         | 27         | 1126      | 15                  |
| 40X             | 110.30        | 5037.6              | 522       | 1064           | 12            | 12         | 18         | 1001      | 12                  |
| 40W             | -             | 5037.9              | 523       | 1064           | -             | 24         | 30         | 1001      | 24                  |
| 40Y             | 110.35        | 5056.8              | 586       | 1064           | 36            | 36         | 42         | 1127      | 30                  |
| 40Z             | -             | 5057.1              | 587       | 1064           | -             | 21         | 27         | 1127      | 15                  |
| 41X             | 110.40        | -                   | -         | 1065           | 12            | -          | -          | 1002      | 12                  |
| 41Y             | 110.45        | 5057.4              | 588       | 1065           | 36            | 36         | 42         | 1128      | 30                  |
| 41Z             | -             | 5057.7              | 589       | 1065           | -             | 21         | 27         | 1128      | 15                  |
| 42X             | 110.50        | 5038.2              | 524       | 1066           | 12            | 12         | 18         | 1003      | 12                  |
| 42W             | -             | 5038.5              | 525       | 1066           | -             | 24         | 30         | 1003      | 24                  |
| 42Y             | 110.55        | 5058.0              | 590       | 1066           | 36            | 36         | 42         | 1129      | 30                  |
| 42Z             | -             | 5058.3              | 591       | 1066           | -             | 21         | 27         | 1129      | 15                  |
| 43X             | 110.60        | -                   | -         | 1067           | 12            | -          | -          | 1004      | 12                  |
| 43Y             | 110.65        | 5058.6              | 592       | 1067           | 36            | 36         | 42         | 1130      | 30                  |
| 43Z             | -             | 5058.9              | 593       | 1067           | -             | 21         | 27         | 1130      | 15                  |
| 44X             | 110.70        | 5038.8              | 526       | 1068           | 12            | 12         | 18         | 1005      | 12                  |
| 44W             | -             | 5039.1              | 527       | 1068           | -             | 24         | 30         | 1005      | 24                  |
| 44Y             | 110.75        | 5059.2              | 594       | 1068           | 36            | 36         | 42         | 1131      | 30                  |
| 44Z             | -             | 5059.5              | 595       | 1068           | -             | 21         | 27         | 1131      | 15                  |
| 45X             | 110.80        | -                   | -         | 1069           | 12            | -          | -          | 1006      | 12                  |
| 45Y             | 110.85        | 5059.8              | 596       | 1069           | 36            | 36         | 42         | 1132      | 30                  |
| 45Z             | -             | 5060.1              | 597       | 1069           | -             | 21         | 27         | 1132      | 15                  |
| 46X             | 110.90        | 5039.4              | 528       | 1070           | 12            | 12         | 18         | 1007      | 12                  |
| 46W             | -             | 5039.7              | 529       | 1070           | -             | 24         | 30         | 1007      | 24                  |
| 46Y             | 110.95        | 5060.4              | 598       | 1070           | 36            | 36         | 42         | 1133      | 30                  |
| 46Z             | -             | 5060.7              | 599       | 1070           | -             | 21         | 27         | 1133      | 15                  |
| 47X             | 111.00        | -                   | -         | 1071           | 12            | -          | -          | 1008      | 12                  |
| 47Y             | 111.05        | 5061.0              | 600       | 1071           | 36            | 36         | 42         | 1134      | 30                  |
| 47Z             | -             | 5061.3              | 601       | 1071           | -             | 21         | 27         | 1134      | 15                  |
| 48X             | 111.10        | 5040.0              | 530       | 1072           | 12            | 12         | 18         | 1009      | 12                  |
| 48W             | -             | 5040.3              | 531       | 1072           | -             | 24         | 30         | 1009      | 24                  |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |            | DME Parameters |               |            |            |           |                     |
|-----------------|---------------|---------------------|------------|----------------|---------------|------------|------------|-----------|---------------------|
|                 |               |                     |            | Interrogation  |               |            |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH. No | Freq. MHz      | Pulse Codes   |            |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |            |                | DME/N $\mu$ s | DME/P Mode |            |           |                     |
|                 |               |                     |            |                |               | IA $\mu$ s | FA $\mu$ s |           |                     |
| 48Y             | 111.15        | 5061.6              | 602        | 1072           | 36            | 36         | 42         | 1135      | 30                  |
| 48Z             | -             | 5061.9              | 603        | 1072           | -             | 21         | 27         | 1135      | 15                  |
| 49X             | 111.20        | -                   | -          | 1073           | 12            | -          | -          | 1010      | 12                  |
| 49Y             | 111.25        | 5062.2              | 604        | 1073           | 36            | 36         | 42         | 1136      | 30                  |
| 49Z             | -             | 5062.5              | 605        | 1073           | -             | 21         | 27         | 1136      | 15                  |
| 50X             | 111.30        | 5040.6              | 532        | 1074           | 12            | 12         | 18         | 1011      | 12                  |
| 50W             | -             | 5040.9              | 533        | 1074           | -             | 24         | 30         | 1011      | 24                  |
| 50Y             | 111.35        | 5062.8              | 606        | 1074           | 36            | 36         | 42         | 1137      | 30                  |
| 50Z             | -             | 5063.1              | 607        | 1074           | -             | 21         | 27         | 1137      | 15                  |
| 51X             | 111.40        | -                   | -          | 1075           | 12            | -          | -          | 1012      | 12                  |
| 51Y             | 111.45        | 5063.4              | 608        | 1075           | 36            | 36         | 42         | 1138      | 30                  |
| 51Z             | -             | 5063.7              | 609        | 1075           | -             | 21         | 27         | 1138      | 15                  |
| 52X             | 111.50        | 5041.2              | 534        | 1076           | 12            | 12         | 18         | 1013      | 12                  |
| 52W             | -             | 5041.5              | 535        | 1076           | -             | 24         | 30         | 1013      | 24                  |
| 52Y             | 111.55        | 5064.0              | 610        | 1076           | 36            | 36         | 42         | 1139      | 30                  |
| 52Z             | -             | 5064.3              | 611        | 1076           | -             | 21         | 27         | 1139      | 15                  |
| 53X             | 111.60        | -                   | -          | 1077           | 12            | -          | -          | 1014      | 12                  |
| 53Y             | 111.65        | 5064.6              | 612        | 1077           | 36            | 36         | 42         | 1140      | 30                  |
| 53Z             | -             | 5064.9              | 613        | 1077           | -             | 21         | 27         | 1140      | 15                  |
| 54X             | 111.70        | 5041.8              | 536        | 1078           | 12            | 12         | 18         | 1015      | 12                  |
| 54W             | -             | 5042.1              | 537        | 1078           | -             | 24         | 30         | 1015      | 24                  |
| 54Y             | 111.75        | 5065.2              | 614        | 1078           | 36            | 36         | 42         | 1141      | 30                  |
| 54Z             | -             | 5065.5              | 615        | 1078           | -             | 21         | 27         | 1141      | 15                  |
| 55X             | 111.80        | -                   | -          | 1079           | 12            | -          | -          | 1016      | 12                  |
| 55Y             | 111.85        | 5065.8              | 616        | 1079           | 36            | 36         | 42         | 1142      | 30                  |
| 55Z             | -             | 5066.1              | 617        | 1079           | -             | 21         | 27         | 1142      | 15                  |
| 56X             | 111.90        | 5042.4              | 538        | 1080           | 12            | 12         | 18         | 1017      | 12                  |
| 56W             | -             | 5042.7              | 539        | 1080           | -             | 24         | 30         | 1017      | 24                  |
| 56Y             | 111.95        | 5066.4              | 618        | 1080           | 36            | 36         | 42         | 1143      | 30                  |
| 56Z             | -             | 5066.7              | 619        | 1080           | -             | 21         | 27         | 1143      | 15                  |
| 57X             | 112.00        | -                   | -          | 1081           | 12            | -          | -          | 1018      | 12                  |
| 57Y             | 112.05        | -                   | -          | 1081           | 36            | -          | -          | 1144      | 30                  |
| 58X             | 112.10        | -                   | -          | 1082           | 12            | -          | -          | 1019      | 12                  |
| 58Y             | 112.15        | -                   | -          | 1082           | 36            | -          | -          | 1145      | 30                  |
| 59X             | 112.20        | -                   | -          | 1083           | 12            | -          | -          | 1020      | 12                  |
| 59Y             | 112.25        | -                   | -          | 1083           | 36            | -          | -          | 1146      | 30                  |
| **60X           | -             | -                   | -          | 1084           | 12            | -          | -          | 1021      | 12                  |
| **60Y           | -             | -                   | -          | 1084           | 36            | -          | -          | 1147      | 30                  |
| **61X           | -             | -                   | -          | 1085           | 12            | -          | -          | 1022      | 12                  |
| **61Y           | -             | -                   | -          | 1085           | 36            | -          | -          | 1148      | 30                  |
| **62X           | -             | -                   | -          | 1086           | 12            | -          | -          | 1023      | 12                  |
| **62Y           | -             | -                   | -          | 1086           | 36            | -          | -          | 1149      | 30                  |
| **63X           | -             | -                   | -          | 1037           | 12            | -          | -          | 1024      | 12                  |
| **63Y           | -             | -                   | -          | 1087           | 36            | -          | -          | 1150      | 30                  |
| **64X           | -             | -                   | -          | 1088           | 12            | -          | -          | 1151      | 12                  |
| **64Y           | -             | -                   | -          | 1088           | 36            | -          | -          | 1025      | 30                  |
| **65X           | -             | -                   | -          | 1089           | 12            | -          | -          | 1152      | 12                  |
| **65Y           | -             | -                   | -          | 1089           | 36            | -          | -          | 1026      | 30                  |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |            | DME Parameters |               |             |            |           |                     |
|-----------------|---------------|---------------------|------------|----------------|---------------|-------------|------------|-----------|---------------------|
|                 |               |                     |            | Interrogation  |               |             |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH. No | Freq. MHz      | DME/N $\mu$ s | Pulse Codes |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |            |                |               | DME/P Mode  |            |           |                     |
|                 |               |                     |            |                |               | IA $\mu$ s  | FA $\mu$ s |           |                     |
| **66X           | -             | -                   | -          | 1090           | 12            | -           | -          | 1153      | 12                  |
| **66Y           | -             | -                   | -          | 1090           | 36            | -           | -          | 1027      | 30                  |
| **67X           | -             | -                   | -          | 1091           | 12            | -           | -          | 1154      | 12                  |
| **67Y           | -             | -                   | -          | 1091           | 36            | -           | -          | 1028      | 30                  |
| **68X           | -             | -                   | -          | 1092           | 12            | -           | -          | 1155      | 12                  |
| **68Y           | -             | -                   | -          | 1092           | 36            | -           | -          | 1029      | 30                  |
| **69X           | -             | -                   | -          | 1093           | 12            | -           | -          | 1156      | 12                  |
| **69Y           | -             | -                   | -          | 1093           | 36            | -           | -          | 1030      | 30                  |
| 70X             | 112.30        | -                   | -          | 1094           | 12            | -           | -          | 1157      | 12                  |
| **70Y           | 112.35        | -                   | -          | 1094           | 36            | -           | -          | 1031      | 30                  |
| 71X             | 112.40        | -                   | -          | 1095           | 12            | -           | -          | 1158      | 12                  |
| **71Y           | 112.45        | -                   | -          | 1095           | 36            | -           | -          | 1032      | 30                  |
| 72X             | 112.50        | -                   | -          | 1096           | 12            | -           | -          | 1159      | 12                  |
| **72Y           | 112.55        | -                   | -          | 1096           | 36            | -           | -          | 1033      | 30                  |
| 73X             | 112.60        | -                   | -          | 1097           | 12            | -           | -          | 1160      | 12                  |
| **73Y           | 112.65        | -                   | -          | 1097           | 36            | -           | -          | 1034      | 30                  |
| 74X             | 112.70        | -                   | -          | 1098           | 12            | -           | -          | 1161      | 12                  |
| **74Y           | 112.75        | -                   | -          | 1098           | 36            | -           | -          | 1035      | 30                  |
| 75X             | 112.80        | -                   | -          | 1099           | 12            | -           | -          | 1162      | 12                  |
| **75Y           | 112.85        | -                   | -          | 1099           | 36            | -           | -          | 1036      | 30                  |
| 76X             | 112.90        | -                   | -          | 1100           | 12            | -           | -          | 1163      | 12                  |
| **76Y           | 112.95        | -                   | -          | 1100           | 36            | -           | -          | 1037      | 30                  |
| 77X             | 113.00        | -                   | -          | 1101           | 12            | -           | -          | 1164      | 12                  |
| **77Y           | 113.05        | -                   | -          | 1101           | 36            | -           | -          | 1038      | 30                  |
| 78X             | 113.10        | -                   | -          | 1102           | 12            | -           | -          | 1165      | 12                  |
| **78Y           | 113.15        | -                   | -          | 1102           | 36            | -           | -          | 1039      | 30                  |
| 79X             | 113.20        | -                   | -          | 1103           | 12            | -           | -          | 1166      | 12                  |
| **79Y           | 113.25        | -                   | -          | 1103           | 36            | -           | -          | 1040      | 30                  |
| 80X             | 113.30        | -                   | -          | 1104           | 12            | -           | -          | 1167      | 12                  |
| 80Y             | 113.35        | 5067.0              | 620        | 1104           | 36            | 36          | 42         | 1041      | 30                  |
| 80Z             | -             | 5067.3              | 621        | 1104           | -             | 21          | 27         | 1041      | 15                  |
| 81X             | 113.40        | -                   | -          | 1105           | 12            | -           | -          | 1168      | 12                  |
| 81Y             | 113.45        | 5067.6              | 622        | 1105           | 36            | 36          | 42         | 1042      | 30                  |
| 81Z             | -             | 5067.9              | 623        | 1105           | -             | 21          | 27         | 1042      | 15                  |
| 82X             | 113.50        | -                   | -          | 1106           | 12            | -           | -          | 1169      | 12                  |
| 82Y             | 113.55        | 5068.2              | 624        | 1106           | 36            | 36          | 42         | 1043      | 30                  |
| 82Z             | -             | 5068.5              | 625        | 1106           | -             | 21          | 27         | 1043      | 15                  |
| 83X             | 113.60        | -                   | -          | 1107           | 12            | -           | -          | 1170      | 12                  |
| 83Y             | 113.65        | 5068.8              | 626        | 1107           | 36            | 36          | 42         | 1044      | 30                  |
| 83Z             | -             | 5069.1              | 627        | 1107           | -             | 21          | 27         | 1044      | 15                  |
| 84X             | 113.70        | -                   | -          | 1108           | 12            | -           | -          | 1171      | 12                  |
| 84Y             | 113.75        | 5069.4              | 628        | 1108           | 36            | 36          | 42         | 1045      | 30                  |
| 84Z             | -             | 5069.7              | 629        | 1108           | -             | 21          | 27         | 1045      | 15                  |
| 85X             | 113.80        | -                   | -          | 1109           | 12            | -           | -          | 1172      | 12                  |
| 85Y             | 113.85        | 5070.0              | 630        | 1109           | 36            | 36          | 42         | 1046      | 30                  |
| 85Z             | -             | 5070.3              | 631        | 1109           | -             | 21          | 27         | 1046      | 15                  |
| 86X             | 113.90        | -                   | -          | 1110           | 12            | -           | -          | 1173      | 12                  |
| 86Y             | 113.95        | 5070.6              | 632        | 1110           | 36            | 36          | 42         | 1047      | 30                  |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |            | DME Parameters |               |            |            |           |                     |
|-----------------|---------------|---------------------|------------|----------------|---------------|------------|------------|-----------|---------------------|
|                 |               |                     |            | Interrogation  |               |            |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH. No | Freq. MHz      | Pulse Codes   |            |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |            |                | DME/N $\mu$ s | DME/P Mode |            |           |                     |
|                 |               |                     |            |                |               | IA $\mu$ s | FA $\mu$ s |           |                     |
| 86Z             | -             | 5070.9              | 633        | 1110           | -             | 21         | 27         | 1047      | 15                  |
| 87X             | 114.00        | -                   | -          | 1111           | 12            | -          | -          | 1174      | 12                  |
| 87Y             | 114.05        | 5071.2              | 634        | 1111           | 36            | 36         | 42         | 1048      | 30                  |
| 87Z             | -             | 5071.5              | 635        | 1111           | -             | 21         | 27         | 1048      | 15                  |
| 88X             | 114.10        | -                   | -          | 1112           | 12            | -          | -          | 1175      | 12                  |
| 88Y             | 114.15        | 5071.8              | 636        | 1112           | 36            | 36         | 42         | 1049      | 30                  |
| 88Z             | -             | 5072.1              | 637        | 1112           | -             | 21         | 27         | 1049      | 15                  |
| 89X             | 114.20        | -                   | -          | 1113           | 12            | -          | -          | 1176      | 12                  |
| 89Y             | 114.25        | 5072.4              | 638        | 1113           | 36            | 36         | 42         | 1050      | 30                  |
| 89Z             | -             | 5072.7              | 639        | 1113           | -             | 21         | 27         | 1050      | 15                  |
| 90X             | 114.30        | -                   | -          | 1114           | 12            | -          | -          | 1177      | 12                  |
| 90Y             | 114.35        | 5073.0              | 640        | 1114           | 36            | 36         | 42         | 1051      | 30                  |
| 90Z             | -             | 5073.3              | 641        | 1114           | -             | 21         | 27         | 1051      | 15                  |
| 91X             | 114.40        | -                   | -          | 1115           | 12            | -          | -          | 1178      | 12                  |
| 91Y             | 114.45        | 5073.6              | 642        | 1115           | 36            | 36         | 42         | 1052      | 30                  |
| 91Z             | -             | 5073.9              | 643        | 1115           | -             | 21         | 27         | 1052      | 15                  |
| 92X             | 114.50        | -                   | -          | 1116           | 12            | -          | -          | 1179      | 12                  |
| 92Y             | 114.55        | 5074.2              | 644        | 1116           | 36            | 36         | 42         | 1053      | 30                  |
| 92Z             | -             | 5074.5              | 645        | 1116           | -             | 21         | 27         | 1053      | 15                  |
| 93X             | 114.60        | -                   | -          | 1117           | 12            | -          | -          | 1180      | 12                  |
| 93Y             | 114.65        | 5074.8              | 646        | 1117           | 36            | 36         | 42         | 1054      | 30                  |
| 93Z             | -             | 5075.1              | 647        | 1117           | -             | 21         | 27         | 1054      | 15                  |
| 94X             | 114.70        | -                   | -          | 1118           | 12            | -          | -          | 1181      | 12                  |
| 94Y             | 114.75        | 5075.4              | 648        | 1118           | 36            | 36         | 42         | 1055      | 30                  |
| 94Z             | -             | 5075.7              | 649        | 1118           | -             | 21         | 27         | 1055      | 15                  |
| 95X             | 114.80        | -                   | -          | 1119           | 12            | -          | -          | 1182      | 12                  |
| 95Y             | 114.85        | 5076.0              | 650        | 1119           | 36            | 36         | 42         | 1056      | 30                  |
| 95Z             | -             | 5076.3              | 651        | 1119           | -             | 21         | 27         | 1056      | 15                  |
| 96X             | 114.90        | -                   | -          | 1120           | 12            | -          | -          | 1183      | 12                  |
| 96Y             | 114.95        | 5076.6              | 652        | 1120           | 36            | 36         | 42         | 1057      | 30                  |
| 96Z             | -             | 5076.9              | 653        | 1120           | -             | 21         | 27         | 1057      | 15                  |
| 97X             | 115.00        | -                   | -          | 1121           | 12            | -          | -          | 1184      | 12                  |
| 97Y             | 115.05        | 5077.2              | 654        | 1121           | 36            | 36         | 42         | 1058      | 30                  |
| 97Z             | -             | 5077.5              | 655        | 1121           | -             | 21         | 27         | 1058      | 15                  |
| 98X             | 115.10        | -                   | -          | 1122           | 12            | -          | -          | 1185      | 12                  |
| 98Y             | 115.15        | 5077.8              | 656        | 1122           | 36            | 36         | 42         | 1059      | 30                  |
| 98Z             | -             | 5078.1              | 657        | 1122           | -             | 21         | 27         | 1059      | 15                  |
| 99X             | 115.20        | -                   | -          | 1123           | 12            | -          | -          | 1186      | 12                  |
| 99Y             | 115.25        | 5078.4              | 658        | 1123           | 36            | 36         | 42         | 1060      | 30                  |
| 99Z             | -             | 5078.7              | 659        | 1123           | -             | 21         | 27         | 1060      | 15                  |
| 100X            | 115.30        | -                   | -          | 1124           | 12            | -          | -          | 1187      | 12                  |
| 100Y            | 115.35        | 5079.0              | 660        | 1124           | 36            | 36         | 42         | 1061      | 30                  |
| 100Z            | -             | 5079.3              | 661        | 1124           | -             | 21         | 27         | 1061      | 15                  |
| 101X            | 115.40        | -                   | -          | 1125           | 12            | -          | -          | 1188      | 12                  |
| 101Y            | 115.45        | 5079.6              | 662        | 1125           | 36            | 36         | 42         | 1062      | 30                  |
| 101Z            | -             | 5079.9              | 663        | 1125           | -             | 21         | 27         | 1062      | 15                  |
| 102X            | 115.50        | -                   | -          | 1126           | 12            | -          | -          | 1189      | 12                  |
| 102Y            | 115.55        | 5080.2              | 664        | 1126           | 36            | 36         | 42         | 1063      | 30                  |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |              |                    |           | DME Parameters |             |            |       |           |                |
|-----------------|--------------|--------------------|-----------|----------------|-------------|------------|-------|-----------|----------------|
|                 |              |                    |           | Interrogation  |             |            |       | Reply     |                |
| DME No          | VHF Freq MHz | MLS Angle Freq MHz | MLS CH No | Freq. MHz      | Pulse Codes |            |       | Freq. MHz | Pulse Codes us |
|                 |              |                    |           |                | DME/N us    | DME/P Mode |       |           |                |
|                 |              |                    |           |                |             | IA us      | FA us |           |                |
| 102Z            | -            | 5080.5             | 665       | 1126           | -           | 21         | 27    | 1063      | 15             |
| 103X            | 115.60       | -                  | -         | 1127           | 12          | -          | -     | 1190      | 12             |
| 103Y            | 115.65       | 5080.8             | 666       | 1127           | 36          | 36         | 42    | 1064      | 30             |
| 103Z            | -            | 5081.1             | 667       | 1127           | -           | 21         | 27    | 1064      | 15             |
| 104X            | 115.70       | -                  | -         | 1128           | 12          | -          | -     | 1191      | 12             |
| 104Y            | 115.75       | 5081.4             | 668       | 1128           | 36          | 36         | 42    | 1065      | 30             |
| 104Z            | -            | 5081.7             | 669       | 1128           | -           | 21         | 27    | 1065      | 15             |
| 105X            | 115.80       | -                  | -         | 1129           | 12          | -          | -     | 1192      | 12             |
| 105Y            | 115.85       | 5082.0             | 670       | 1129           | 36          | 36         | 42    | 1066      | 30             |
| 105Z            | -            | 5082.3             | 671       | 1129           | -           | 21         | 27    | 1066      | 15             |
| 106X            | 115.90       | -                  | -         | 1130           | 12          | -          | -     | 1193      | 12             |
| 106Y            | 115.95       | 5082.6             | 672       | 1130           | 36          | 36         | 42    | 1067      | 30             |
| 106Z            | -            | 5082.9             | 673       | 1130           | -           | 21         | 27    | 1067      | 15             |
| 107X            | 116.00       | -                  | -         | 1131           | 12          | -          | -     | 1194      | 12             |
| 107Y            | 116.05       | 5083.2             | 674       | 1131           | 36          | 36         | 42    | 1068      | 30             |
| 107Z            | -            | 5083.5             | 675       | 1131           | -           | 21         | 27    | 1068      | 15             |
| 108X            | 116.10       | -                  | -         | 1132           | 12          | -          | -     | 1195      | 12             |
| 108Y            | 116.15       | 5083.8             | 676       | 1132           | 36          | 36         | 42    | 1069      | 30             |
| 108Z            | -            | 5084.1             | 677       | 1132           | -           | 21         | 27    | 1069      | 15             |
| 109X            | 116.20       | -                  | -         | 1133           | 12          | -          | -     | 1196      | 12             |
| 109Y            | 116.25       | 5084.4             | 678       | 1133           | 36          | 36         | 42    | 1070      | 30             |
| 109Z            | -            | 5084.7             | 679       | 1133           | -           | 21         | 27    | 1070      | 15             |
| 110X            | 116.30       | -                  | -         | 1134           | 12          | -          | -     | 1197      | 12             |
| 110Y            | 116.35       | 5085.0             | 680       | 1134           | 36          | 36         | 42    | 1071      | 30             |
| 110Z            | -            | 5085.3             | 681       | 1134           | -           | 21         | 27    | 1071      | 15             |
| 111X            | 116.40       | -                  | -         | 1135           | 12          | -          | -     | 1198      | 12             |
| 111Y            | 116.45       | 5085.6             | 682       | 1135           | 36          | 36         | 42    | 1072      | 30             |
| 111Z            | -            | 5085.9             | 683       | 1135           | -           | 21         | 27    | 1072      | 15             |
| 112X            | 116.50       | -                  | -         | 1136           | 12          | -          | -     | 1199      | 12             |
| 112Y            | 116.55       | 5086.2             | 684       | 1136           | 36          | 36         | 42    | 1073      | 30             |
| 112Z            | -            | 5086.5             | 685       | 1136           | -           | 21         | 27    | 1073      | 15             |
| 113X            | 116.60       | -                  | -         | 1137           | 12          | -          | -     | 1200      | 12             |
| 113Y            | 116.65       | 5086.8             | 686       | 1137           | 36          | 36         | 42    | 1074      | 30             |
| 113Z            | -            | 5087.1             | 687       | 1137           | -           | 21         | 27    | 1074      | 15             |
| 114X            | 116.70       | -                  | -         | 1138           | 12          | -          | -     | 1201      | 12             |
| 114Y            | 116.75       | 5087.4             | 688       | 1138           | 36          | 36         | 42    | 1075      | 30             |
| 114Z            | -            | 5087.7             | 689       | 1138           | -           | 21         | 27    | 1075      | 15             |
| 115X            | 116.80       | -                  | -         | 1139           | 12          | -          | -     | 1202      | 12             |
| 115Y            | 116.85       | 5088.0             | 690       | 1139           | 36          | 36         | 42    | 1076      | 30             |
| 115Z            | -            | 5088.3             | 691       | 1139           | -           | 21         | 27    | 1076      | 15             |
| 116X            | 116.90       | -                  | -         | 1140           | 12          | -          | -     | 1203      | 12             |
| 116Y            | 116.95       | 5088.6             | 692       | 1140           | 36          | 36         | 42    | 1077      | 30             |
| 116Z            | -            | 5088.9             | 693       | 1140           | -           | 21         | 27    | 1077      | 15             |
| 117X            | 117.00       | -                  | -         | 1141           | 12          | -          | -     | 1204      | 12             |
| 117Y            | 117.05       | 5089.2             | 694       | 1141           | 36          | 36         | 42    | 1078      | 30             |
| 117Z            | -            | 5089.5             | 695       | 1141           | -           | 21         | 27    | 1078      | 15             |
| 118X            | 117.10       | -                  | -         | 1142           | 12          | -          | -     | 1205      | 12             |
| 118Y            | 117.15       | 5089.8             | 696       | 1142           | 36          | 36         | 42    | 1079      | 30             |

Table 12. MLS Channel Pairing (cont)

| Channel Pairing |               |                     |           | DME Parameters |               |            |            |           |                     |
|-----------------|---------------|---------------------|-----------|----------------|---------------|------------|------------|-----------|---------------------|
|                 |               |                     |           | Interrogation  |               |            |            | Reply     |                     |
| DME No          | VHF Freq. MHz | MLS Angle Freq. MHz | MLS CH No | Freq. MHz      | Pulse Codes   |            |            | Freq. MHz | Pulse Codes $\mu$ s |
|                 |               |                     |           |                | DME/N $\mu$ s | DME/P Mode |            |           |                     |
|                 |               |                     |           |                |               | IA $\mu$ s | FA $\mu$ s |           |                     |
| 118Z            | -             | 5090.1              | 697       | 1142           | -             | 21         | 27         | 1079      | 15                  |
| 119X            | 117.20        | -                   | -         | 1143           | 12            | -          | -          | 1206      | 12                  |
| 119Y            | 117.25        | 5090.4              | 698       | 1143           | 36            | 36         | 42         | 1080      | 30                  |
| 119Z            | -             | 5090.7              | 699       | 1143           | -             | 21         | 27         | 1080      | 15                  |
| 120X            | 117.30        | -                   | -         | 1144           | 12            | -          | -          | 1207      | 12                  |
| 120Y            | 117.35        | -                   | -         | 1144           | 36            | -          | -          | 1081      | 30                  |
| 121X            | 117.40        | -                   | -         | 1145           | 12            | -          | -          | 1208      | 12                  |
| 121Y            | 117.45        | -                   | -         | 1145           | 36            | -          | -          | 1082      | 30                  |
| 122X            | 117.50        | -                   | -         | 1146           | 12            | -          | -          | 1209      | 12                  |
| 122Y            | 117.55        | -                   | -         | 1146           | 36            | -          | -          | 1083      | 30                  |
| 123X            | 117.60        | -                   | -         | 1147           | 12            | -          | -          | 1210      | 12                  |
| 123Y            | 117.65        | -                   | -         | 1147           | 36            | -          | -          | 1084      | 30                  |
| 124X            | 117.70        | -                   | -         | 1148           | 12            | -          | -          | 1211      | 12                  |
| **124Y          | 117.75        | -                   | -         | 1148           | 36            | -          | -          | 1085      | 30                  |
| 125X            | 117.80        | -                   | -         | 1149           | 12            | -          | -          | 1212      | 12                  |
| **125Y          | 117.85        | -                   | -         | 1149           | 36            | -          | -          | 1086      | 30                  |
| 126X            | 117.90        | -                   | -         | 1150           | 12            | -          | -          | 1213      | 12                  |
| **126Y          | 117.95        | -                   | -         | 1150           | 36            | -          | -          | 1087      | 30                  |

**NOTES:**

- \* These channels are reserved exclusively for national allotments.
- \*\* These channels may be used for national allotment on a secondary basis. The primary reason for reserving these channels is to provide protection for the Secondary Surveillance Radar (SSR) system.
- ▽ 108.0 MHz is not scheduled for assignment to ILS service. The associated DME operating channel No. 17X may be assigned to the emergency service.



## APPENDIX II

20. FUNCTION TIMING TABLES

20.1 Event time slots of angle and data functions.— The event times for angle and data functions shall be as shown in the following tables and as described in 4.1. The times indicate the beginning of the listed event time slot and the end of the previous time slot.

Table 14. Approach Azimuth Function Timing

| <u>EVENT</u>            | EVENT TIME SLOT BEGINS AT:      |                                |
|-------------------------|---------------------------------|--------------------------------|
|                         | <u>CLOCK PULSE<br/>(NUMBER)</u> | <u>TIME<br/>(milliseconds)</u> |
| PREAMBLE                | 0                               | 0                              |
| UNUSED (TRANSMIT ZERO)  | 25                              | 1.600                          |
| ANTENNA SELECT          | 26                              | 1.664                          |
| OCI                     | 32                              | 2.048                          |
| OCI                     | 34                              | 2.176                          |
| OCI                     | 36                              | 2.304                          |
| TO TEST                 | 38                              | 2.432                          |
| TO SCAN*                | 40                              | 2.560                          |
| PAUSE                   |                                 | 8.760                          |
| MIDSCAN POINT           |                                 | 9.060                          |
| FRO SCAN*               |                                 | 9.360                          |
| FRO TEST                |                                 | 15.560                         |
| END FUNCTION (AIRBORNE) |                                 | 15.688                         |
| END GUARD TIME;         |                                 | 15.900                         |
| END FUNCTION (GROUND)   |                                 |                                |

- \* The actual commencement and completion of the TO and the FRO scan transmissions are dependent on the amount of proportional guidance provided. The time slots provided shall accommodate a maximum scan of plus or minus 62.0 degrees. Scan timing shall be compatible with accuracy requirements.

Table 15. High Rate Approach Azimuth and Back Azimuth Function Timing

| <u>EVENT</u>            | EVENT TIME SLOT BEGINS AT:            |                        |
|-------------------------|---------------------------------------|------------------------|
|                         | 15.625 kHz<br>CLOCK PULSE<br>(NUMBER) | TIME<br>(milliseconds) |
| PREAMBLE                | 0                                     | 0                      |
| UNUSED (TRANSMIT ZERO)  | 25                                    | 1.600                  |
| ANTENNA SELECT          | 26                                    | 1.664                  |
| OCI                     | 32                                    | 2.048                  |
| OCI                     | 34                                    | 2.176                  |
| OCI                     | 36                                    | 2.304                  |
| TO TEST                 | 38                                    | 2.432                  |
| TO SCAN*                | 40                                    | 2.560                  |
| PAUSE                   |                                       | 6.760                  |
| MIDSCAN POINT           |                                       | 7.060                  |
| FRO SCAN*               |                                       | 7.360                  |
| FRO TEST PULSE          |                                       | 11.560                 |
| END FUNCTION (AIRBORNE) |                                       | 11.688                 |
| END GUARD TIME;         |                                       | 11.900                 |
| END FUNCTION (GROUND)   |                                       |                        |

- \* The actual commencement and completion of the TO and the FRO scan transmissions are dependent on the amount of proportional guidance provided. The time slots provided will accommodate a maximum scan of plus or minus 42.0 degrees. Scan timing shall be compatible with accuracy requirements.

Table 16. Approach Elevation Function Timing

| <u>EVENT</u>                             | EVENT TIME SLOT BEGINS AT:            |                        |
|--|---------------------------------------|------------------------|
|  | 15.625 kHz<br>CLOCK PULSE<br>(NUMBER) | TIME<br>(milliseconds) |
| PREAMBLE                                 | 0                                     | 0                      |
| PROCESSOR PAUSE                          | 25                                    | 1.600                  |
| OCI                                      | 27                                    | 1.728                  |
| TO SCAN*                                 | 29                                    | 1.856                  |
| PAUSE                                    |                                       | 3.406                  |
| MIDSCAN POINT                            |                                       | 3.606                  |
| FRO SCAN*                                |                                       | 3.806                  |
| END FUNCTION (AIRBORNE)                  |                                       | 5.356                  |
| END GUARD TIME;<br>END FUNCTION (GROUND) |                                       | 5.600                  |

- \* The actual commencement and completion of the TO and FRO scan transmissions are dependent upon the amount of proportional guidance provided. The time slots provided will accommodate a maximum scan of -1.5 degrees to +29.5 degrees. Scan timing shall be compatible with accuracy requirements.

Table 17. Basic Data Function Timing

| <u>EVENT</u>                             | EVENT TIME SLOT BEGINS AT:            |                        |
|--|---------------------------------------|------------------------|
|  | 15.625 kHz<br>CLOCK PULSE<br>(NUMBER) | TIME<br>(milliseconds) |
| PREAMBLE                                 | 0                                     | 0                      |
| DATA TRANSMISSION:<br>(BITS I13 - I30)   | 25                                    | 1.600                  |
| PARITY TRANSMISSION:<br>(BITS I31 - I32) | 43                                    | 2.752                  |
| END FUNCTION (AIRBORNE)                  | 45                                    | 2.880                  |
| END GUARD TIME;<br>END FUNCTION (GROUND) |                                       | 3.100                  |

Table 18. Auxiliary Data Function Timing (Digital Data)

| <u>EVENT</u>   | EVENT TIME SLOT BEGINS AT:            |                        |
|--|---------------------------------------|------------------------|
|  | 15.625 kHz<br>CLOCK PULSE<br>(NUMBER) | TIME<br>(milliseconds) |
| PREAMBLE   | 0                                     | 0                      |
| ADDRESS TRANSMISSION<br>(BITS I <sub>13</sub> -I <sub>20</sub> ) | 25                                    | 1.600                  |
| DATA TRANSMISSION:<br>(BITS I <sub>21</sub> -I <sub>69</sub> )   | 33                                    | 2.112                  |
| PARITY TRANSMISSION:<br>(BITS I <sub>70</sub> -I <sub>76</sub> ) | 82                                    | 5.248                  |
| END FUNCTION (AIRBORNE)  | 89                                    | 5.696                  |
| END GUARD TIME;<br>END FUNCTION (GROUND)                         | --                                    | 5.900                  |

Table 19. Preamble Timing\*

| <u>EVENT</u>                              | EVENT TIME SLOT BEGINS AT:            |                        |
|---|---------------------------------------|------------------------|
|   | 15.625 kHz<br>CLOCK PULSE<br>(NUMBER) | TIME<br>(milliseconds) |
| CARRIER ACQUISITION:<br>(CW TRANSMISSION) | 0                                     | 0                      |
| RECEIVER REFERENCE TIME CODE              |                                       |                        |
| I1 = 1                                    | 13                                    | 0.832                  |
| I2 = 1                                    | 14                                    | 0.896                  |
| I3 = 1                                    | 15                                    | 0.960                  |
| I4 = 0                                    | 16                                    | 1.024                  |
| I5 = 1                                    | 17                                    | 1.088**                |
| FUNCTION IDENTIFICATION:                  |                                       |                        |
| I6  | 18                                    | 1.152                  |
| I7  | 19                                    | 1.216                  |
| I8  | 20                                    | 1.280                  |
| I9  | 21                                    | 1.344                  |
| I10 (See Table 1)                         | 22                                    | 1.408                  |
| I11                                       | 23                                    | 1.472                  |
| I12                                       | 24                                    | 1.536                  |
| END PREAMBLE                              |                                       | 1.600                  |

\*Applies to all functions transmitted.

\*\*Reference time for receiver synchronization for all function timing.

Table 20. Auxiliary Data Function Timing (Alphanumeric Data)

| <u>EVENT</u>   | EVENT TIME SLOT BEGINS AT:                   |                               |
|--|--|-------------------------------|
|  | 15.625 kHz<br>CLOCK PULSE<br><u>(NUMBER)</u> | TIME<br><u>(milliseconds)</u> |
| PREAMBLE   | 0  | 0                             |
| ADDRESS TRANSMISSION<br>(BITS I <sub>13</sub> -I <sub>20</sub> ) | 25   | 1.600                         |
| DATA TRANSMISSION:<br>(BITS I <sub>21</sub> -I <sub>76</sub> )   | 33   | 2.112                         |
| END FUNCTION (AIRBORNE)  | 89   | 5.696                         |
| END GUARD TIME;<br>END FUNCTION (GROUND)                         | --   | 5.900                         |





